IGOR WITKOWSKI

DIE WAHRHEIT ÜBER DIE WUNDERWAFFE

TEIL 2

GEHEIME WAFFEN-
TECHNOLOGIE
IM DRITTEN REICH

Igor Vitkovsky

The truth about the magic bullet, part 2

Title of the original edition: "Pravda o Wunderwaffe"

German first edition, 2009

German translation: Marek Kosmala

Cover graphic: Tomasz Maros

Layout: Inna Kralovyetts

Mosquito Verlag

www.mosquito-verlag.de

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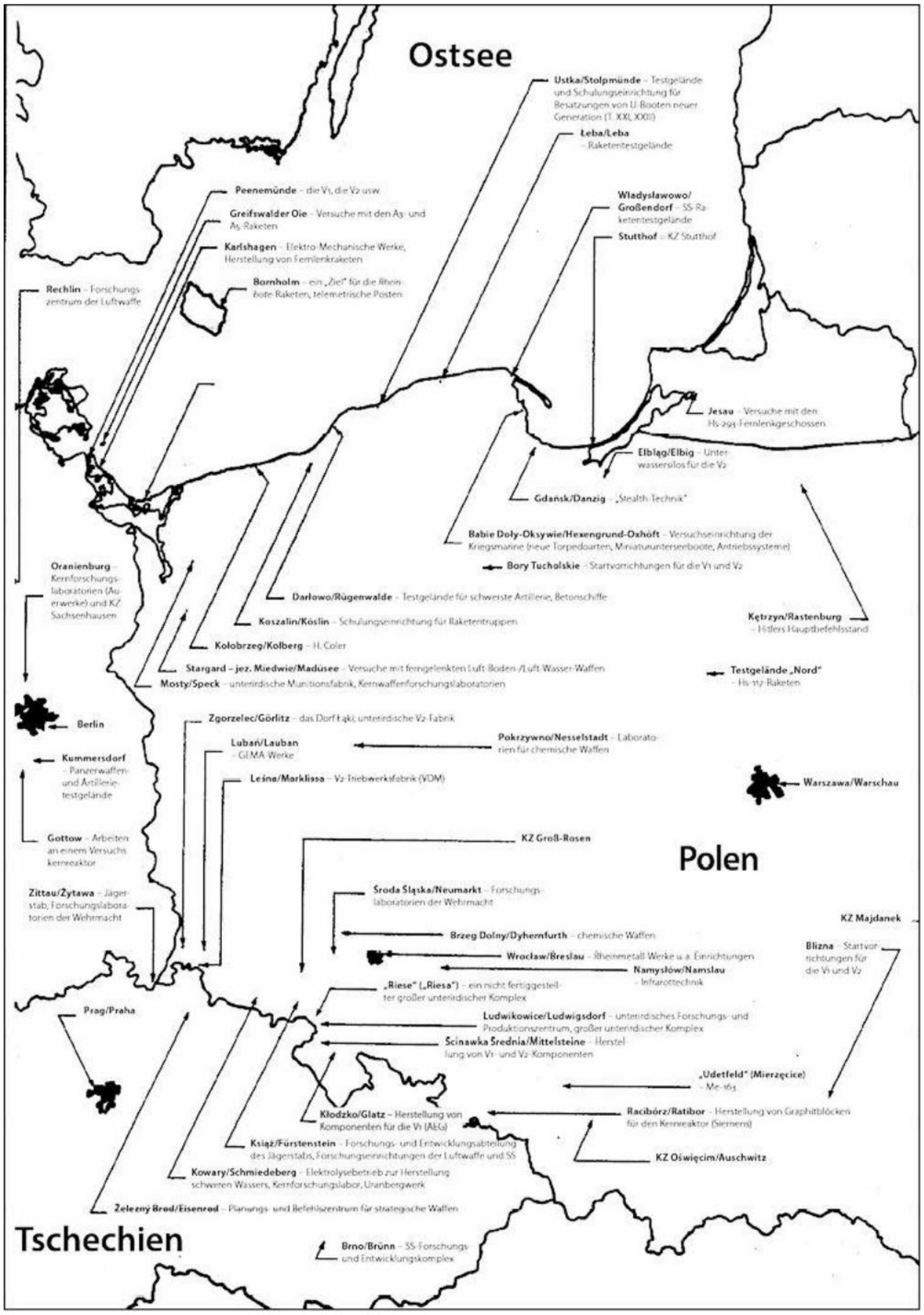
THE TRUTH ABOUT THE MIRACLE WEAPON

Secret weapon technology in the Third Reich

Part 2

Weapons that would have changed the course of the war

"War Critical": The ultra-secret project "The bell"



Selected locations east of Berlin associated with research and development work or the production of German "special weapons"; the three most important concentration camps are also listed. The map shows the post-war border course.

Weapons that would have changed the course of the war

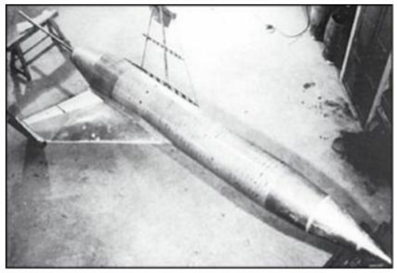
The Rapid Development of Guided Weapons

One of the most important evidence of the importance of the scientific and technical upheaval triggered by the Second World War was the huge number of guided missiles that emerged at that time. In the Third Reich alone, at least 20 types of warheads with homing guidance were designed (the Allies were also able to implement individual concepts in this area). This ushered in a whole new era. The V1 and V2 rockets were just the proverbial tip of the iceberg. Only a very small part of these weapons were used in combat, although technical problems were by no means the biggest hurdle. It was mainly due to the ignorance of Hitler, who forced the mass production of the V1 and V2 at the expense of the remote control weapons, which were actually important for the course of the war. This was especially true for the surface-to-air missiles, because they could have stopped the attack waves of the Allied bombers that were destroying the German armaments industry.
Anti-aircraft missiles were the Third Reich's most dangerous trump card. It is paradoxical that Hitler delayed their development. A similar fate befell the Me-262 fighter aircraft and nuclear weapons, the revolutionary character of which the Fuhrer could not understand. The other types of remote-controlled weapons could also have had a significant impact on the course of the war, but they were only used to a small extent.

My description of these weapons begins with the anti-aircraft missiles.

The fire lily

The *Feuerlilie* was the first remote-controlled anti-aircraft missile developed in the Third Reich (paradoxically, without the participation of specialists from Peenemünde). A whole series of institutions were involved in the work, which was managed by the "Aeronautics Research Institute Herman Göring" in Völkenrode.

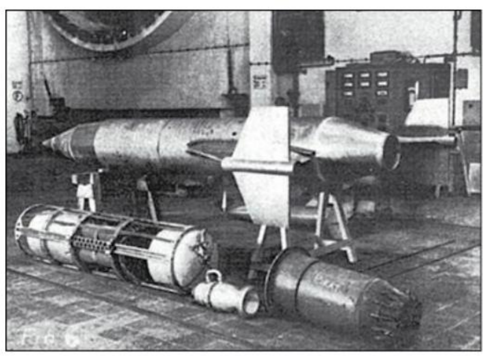


The *Orange Lily* F-55. (Photo: Federal Archives)

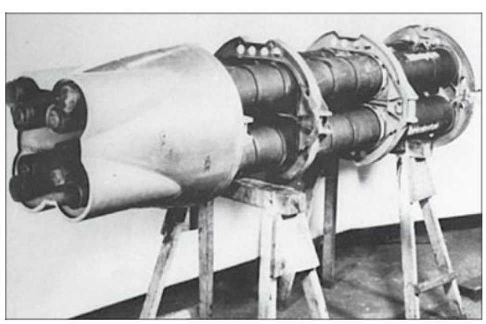
Work on the *Feuerlilie* began in 1942 - almost simultaneously with work on the Hecht 2700 rocket, whose trajectory was programmed before launch and which therefore does not quite deserve the name of a guided missile.

Work was stopped in 1943, but the competition concept was further developed.

The institution with the somewhat long name mentioned above (the abbreviation LFA was also used), which led the work, was one of the leading institutions in the development of German missile weapon systems.



The F-55 variant of the *Tierra del Fuego,* assembled and in parts (foreground). You can see the huge pirate engine and Walter's very small engine in comparison. (Photo: CIOS)



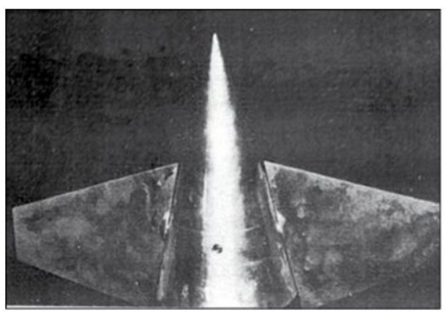
The *Pirate* was composed of four smaller rocket engines. (Photo: Federal Archives)

Here, among other things, a large part of the work in the field of aerodynamics was carried out - calculations were carried out and rocket models examined in the wind tunnel. Two institutes spun off from the LFA were commissioned with these tasks: the Institute for Gas Dynamics (Head: Prof. Busemann, who had also worked on the ramjet engines described below) and the Institute for Aerodynamics, headed by Dr. Blenk was. There was also a wind tunnel there, through which Dr. Zobel-led team was "served". In the Institute of Aerodynamics there was also a department for the development of homing systems for guided missiles, which was headed by Dr. Brown was headed.

A prototype F-55 is prepared for launch. (Photo: Federal Archives)

Prof. Busemann from the Institute for Gas Dynamics was responsible for a team that dealt with the dynamics of supersonic flow (Dr. Guderley). In this institute, among other things, nozzles for rocket engines were designed (Dr. Winkler, Dr. Grumpt), however, conducted no tests with rocket prototypes; there was a regulation according to which launch tests with anti-aircraft missiles powered by liquid fuel had to be carried out on the premises of the research center near Peenemünde, while missiles equipped with solid fuel engines were to be launched at an Luftwaffe test site near ÿeba. The LFA entered uncharted territory in starting work on the *Feuerlilie ,* although it already had modest experience gained during the initial trials of the Hecht rocket prototype. As already mentioned, owned the Hecht rocket

no homing guidance system; however, it was fitted with moveable rudders and its own steering system (which kept the given course). The rocket was tested in flight under conditions that allowed comparing its expected behavior with real flight behavior - it was dropped (without the engine) from an altitude of 2,000 m by an airplane. After reaching the target altitude, a special fuse triggered the parachute, allowing the prototype of the *Hecht* rocket to be modified and examined several times. These tests were significant in that it turned out that this prototype - especially in the beginning - often surprised the designers with its behavior in the air. One could say that the rich theoretical knowledge was enriched by practical experience.



Work on the F-55 homing guidance system was halted at the stage of wind tunnel testing. The nose rudder can be seen in the photo. (Photo: CIOS)

The development of the *Feuerlilie* took place in three phases - first a small model with a fuselage diameter of only two centimeters was studied, then a 2.08 m long "medium rocket" with a diameter of 25 cm was built, and finally prototypes of the final version with a fuselage diameter followed of 55 cm. The "medium version" had a take-off weight of 120 kg, could carry 17 kg of explosives in the warhead and was powered by the Rheinmetall-Borsig 109-505 solid propellant engine. This rocket, which received the designation F-25, had an aerodynamic system typical of a fast aircraft - it had, among other things, trapezoidal wings with a strong leading edge sweep. At the rear were tail fins with attached tailplane, although only the

(horizontal) elevators were connected to a simple gyro control system. This compilation was only tested to determine the relationship between sweep angle and aerodynamic drag for a wide range of speeds. About 30 test launches were conducted, but the usefulness of the data obtained was limited by the inability of the rocket to develop a speed in excess of 220 m/s (792 km/h), the supersonic range for which the F-55 intended could not achieve.

Contrary to the original planning, this rocket never came beyond the experimental stage.

Two versions of the F-55 were developed. The first was a single-stage surface-to-air missile with a launch weight of 473 kg, powered by a Rheinmetall Borsig 109-515 solid propellant engine. The second and final version was a two-stage rocket. The first stage consisted of a huge solid propellant battery (230 kg) and was given the alias *Pirate.* The second stage was equipped with an engine from the company Walter from Kiel, which was powered by liquid fuel. The total weight of the propulsion assembly is not known, but it can be assumed that it well exceeded half a ton.

In early 1944 a prototype of the first version was completed, which fired without any control system (reportedly flew 77 km). In May of the same year, further work on this version was discontinued.

A little later, two prototypes of the two-stage version were completed, but here too homing systems were omitted - both missiles were only equipped with simple gyro-based flight programming devices. They were built solely with the aim of developing optimal algorithms for the control system, which until now has been the main problem. The trials of the two-stage F 55 version were the first that were expected to yield usable data on the missile's behavior in supersonic flight from the point of view of homing guidance. The Germans were unlucky, however. The first prototype hit the ground soon after takeoff, while the second fell under British bombs at the Peenemünde test site

fell victim while being prepared for launch. Despite this painful setback, the LFA continued to attempt to complete development of the F-55. Final modifications were made to the wings and the nose part of the rocket was examined in the wind tunnel, which was fitted with small control surfaces to be moved using the homing system housed in the warhead (this corresponds to the canard wing system with the tailplane attached to the nose).).

There were many indications that after three years of development, the *fire lily project* was nearing completion. At the beginning of February 1945, however, the LFA reached the decision to completely stop all work related to the code name mentioned above.

The reason for this was as follows: As a scientific research institution, the LFA did not build any prototypes and was therefore not considered as a future manufacturer. This task was entrusted to the Ardelt works in Breslau, which had a huge (still mysterious, mind you) underground factory in the Masselwitz district. This decision was made because, after the Russians launched the January offensive, there was a real danger that this super-secret operation and its no less well-kept treasures would fall into enemy hands. Therefore, the order was given to destroy the rocket parts along with the documentation. 102,107,109

The Waterfall (C-2)

The second most important concept that was developed and realized in Peenemünde (EMW) was a guided anti-aircraft missile that was to be much smaller than the V2. She got the 101-2,105-7 She also put the *waterfall.* summit of what was then the code name of the Technik, although it was not favored by Hitler as a defensive weapon (unlike the V2), which, as we know, had an enormously negative impact on the situation of the Third Reich.

The *Wasserfall* was certainly the heaviest and most complicated of all German surface-to-air missiles, in which many innovative solutions were also used. Her takeoff weight was 3,500 kg, but she was still over 3.5 times lighter than the V2. The second fundamental

Difference resulted from the use of completely different, non-cryogenic propellants. The liquid oxygen known from the V2, which was kept in this state (low temperature) by evaporation, was a perfect oxidizer from a chemical point of view. Because of this, however, it was also unstable, which from a military point of view disqualified it from defensive weapons that should be constantly ready for use.

In other words, an oxidizer had to be found that would ensure adequate propulsion efficiency and at the same time could reside in the rocket's fuel tank at all times without incurring any additional overhead. The engineers decided on a mixture of strongly oxidizing acids with the following composition: 90% concentrated nitric acid and 10% concentrated sulfuric acid. It met the criteria above, but in return caused other problems.

The *waterfall* in the W-10 version.

The substance was of course highly corrosive, which presented new challenges for both the designers of the fuel system and the operators. During the launch attempts, highly toxic nitrogen monoxide was also produced, which incidentally gave away the location of the launch pad (the exhaust gases formed a dense, yellow-brown smoke). Due to the different oxidizer, a different fuel had to be used that would react easily with the acids - a self-igniting mixture was provided for this.

After lengthy analysis and investigation, two

developed different fuel mixtures. One was "Visol", which was based on saturated and unsaturated ethane derivatives (C2H5 - OC2H3). The other mixture was "Optolen": It consisted of about 50% Visol, supplemented by aniline (10-20%), the refined coal tar dissolved in the remaining ingredients, and heavy alcohols such as benzene and xylene.

Although from a chemical point of view both fuel mixtures could be considered successful, the oxidizer was clearly the result of a compromise. The proportions used already testify to this – more than three parts of the oxidizer (76 – 77%) went to one part of the fuel, although it was actually the fuel that determined the energetic value of the mixture. However, the "military" goal was achieved: it was assumed that a fuel-filled *waterfall* could be stored maintenance-free for six months, later perhaps even a year.

The *Wasserfall* W-5 ready for launch.

The first technical problem that had to be overcome in this context arose from the design of the oxidizer vessel itself.

Various container variants were practically tested until the beginning of 1945. They were made of the following materials: ordinary steel, coated from the inside with a layer of aluminum (aluminum does not react with nitric acid); manganese steel; chrome steel (4 percent chrome); as well as ordinary enamel steel. The fuel was injected into the rocket engine using compressed nitrogen. In the front part of the hull, just behind the warhead, there was a spherical container filled with 235 l (70 kg) of nitrogen at a pressure of 260 atm. While the engine was operating, this pressure dropped to about 90 atm - the difference was partially compensated for by a pressure reducing valve. The containers were sealed during storage with aluminum membranes, which were torn apart by electrically fired pyrotechnic charges when the missile was launched.

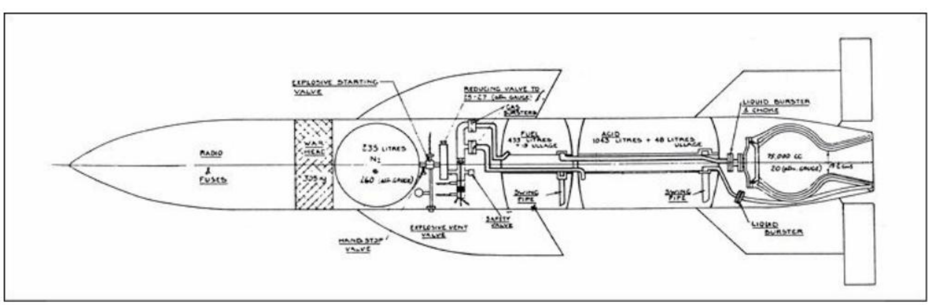
One of the most important elements of the rocket was of course the engine itself. In the last and smallest of the tested rocket variants (W-10), the rocket was able to reach a speed of almost 2,900 km/h in vertical flight. The in-flight acceleration loading varied from about 2.1 G immediately after take-off to 4.5 G in the higher layers of the atmosphere. The power unit could work for a maximum of 41 seconds.

The engine itself was made of ordinary mild steel and was cooled in a similar way to the V2's engine, except that an oxidizer rather than fuel was used for this purpose. Initial calculations showed that the temperature inside the combustion chamber would reach 2,800 °C. However, it turned out that much of the heat escaped with the combustion products, so the actual temperature did not exceed 1,800 °C. The upper part of the engine consisted of a single large injector, which was connected to the combustion chamber by means of a round plate, in which there were several dozen orifices for the injection of fuel and oxidizer. The mixing of the two components took place mainly in the combustion chamber. The engine had no ignition system - the fuel ignited automatically in the presence of concentrated nitric acid. The thrust reached 1,800 kg, although the pressure in the combustion chamber fluctuated "only" by 20 atm. The combustion chamber had a volume of

75 liters, the inner diameter of the nozzle neck being 192 mm.

The problem of control was solved similarly to that of the V2: aerodynamic rudders were installed behind the tail fins, and near the axis were gas-dynamic rudders, which deflected the jet of gas ejected from the engine. However, as the employees of the Electromechanical Works (EMW) in Peenemünde testified after the war, the latter were dispensed with after the first attempts because they "had a negative effect on the flight performance of the rocket".

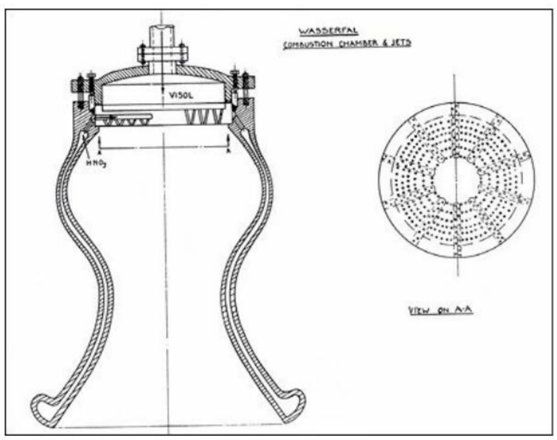
During the war, three basic versions of the *Wasserfall* were developed (W-1, W-5 and W-10), which differed in size, weight and homing system. The first of these (W-1) was already ready for testing at the turn of the year 1943/44. Its development formally began in 1940, i.e. shortly after the outbreak of war. This rocket differed externally from the later development variants by relatively large "wings": Although they had a small sweep, their wingspan was significantly larger than that of the fins. The W-1's takeoff weight was 3,500 kg, with the warhead weighing 235 kg (such a large charge would certainly be enough to destroy group targets). It was controlled via a radio system codenamed *Kehl/ Strassburg:* a ground technician observing the target passed the commands to the rocket using a “joystick”. Such a system was also used on the prototypes of later versions, although a number of much more modern devices were being developed in parallel. The most advanced was a command-based homing system that would replace the ground observer with two radars - one to detect and track the targets, the other to track the missile.



Schematic cross-section of the *waterfall* from an American report. If he

Even approximate true proportions would mean that the warhead took up far less space than the homing system and fuses.
(Photo: CIOS)

Above all, the *Wasserfall* differed from all other remote-controlled anti-aircraft missiles developed in the Third Reich in that it was to be equipped with the most modern homing system, which included a device for independent detection of heat sources and a proximity fuse. A new generation warhead with a significantly higher destructive power was also developed, which was based on an aerosol charge. The first test ignition of the W-1 variant took place on January 8, 1944, but was not crowned with success. Only the second flight on February 29 went according to plan, and the rocket reached a top speed of 2,772 km/h.



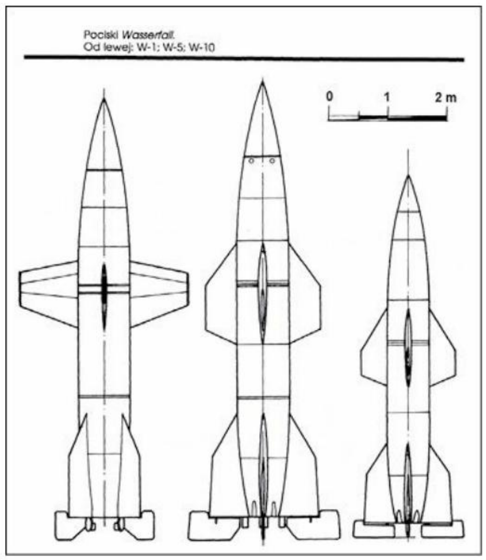
Longitudinal and transverse section of the engine (at the level of the injectors). The cooling system of the jet nozzle is clearly visible. The oxidizer was pressed in from below. (Photo: CIOS)

A few months later, the first, modified W-5 version was tested. This rocket was slightly longer (7,765 m vs. 7,450 m) and had significantly reduced "wings" but increased fins.

Takeoff weight increased from 3,500 to 3,810 kg. The previous shortcomings of the command transmission radio system have been eliminated. The W-5 had a (horizontal) range of 26.4 km at a maximum altitude of 18,300 meters.

The most modern version (W-10) was developed in the second half of 1944. It featured the same weight as the W-1, but due to a rationalization of its design, it had

smaller dimensions. Compared to the W-5, the length has been reduced by over a meter and a half to 6.128 m and the diameter has been reduced from 86.4 cm to 72 cm. The wings and fins were also smaller, with the former being characterized by an even stronger leading edge sweep. This had a significant impact on aerodynamic drag and enabled a record climb speed of 2,855 km/h to be achieved.



The *waterfall rockets.* From left: W-1, W-5, W-10.

Only 40 trials of different versions of the *Wasserfall* were conducted by the end of the war, but this did not stop the Germans from developing mass production plans and planning ring batteries of anti-aircraft missiles to protect the most important cities and areas with the largest number of armaments factories in the Third Reich. In the subterranean rooms of a former mine near Bleicherode, a factory protected from air raids was to be built, in which 900 rockets were to be manufactured monthly at the beginning. This number should be multiplied in the future. Optimistic estimates have been made that the manufacturing cost of a mass-produced rocket should not exceed 10,000 RM.

Albert Speer, Reich Minister for Armament and Munitions, described the sabotage of the waterfall project as one of the greatest mistakes of the Third Reich leadership in his "Memoirs" . This happened in spite of many

"Voices of reason" that reached Hitler even then. To Speer himself: [1]

"Hitler's arguments aside, this reasonable attitude was contradicted by the fact that Peenemünde produced equipment for land forces, while defense against air attack was a matter for the Luftwaffe. Due to the division of interests in the land and air forces, as well as the prevailing ambitions of the Wehrmacht, the land forces would not have been willing to leave the equipment built in Peenemünde to their competitors.
Due to a division between the various armed forces of the Wehrmacht, not even research and design work was possible. If the design potential of Peenemünde had been fully exploited earlier, the *Wasserfall* could have gone into production earlier. On January 1, 1945, 2,210 scientists and engineers were still working on the A4 and A9 long-range rockets in Peenemünde. Only 220 were available for the *Waterfall project,* and another 135 for another anti-aircraft missile, the *Taifun .* That was typical of such a division of priorities.

Almost two months before we made this wrong decision, on June 29, 1943, Professor Dr. C. Krauch, Chief Chemical Officer, states in a detailed memorandum: 'The proponents of the rapid development of airborne means, ie counter-terror, proceed from the assumption that attack is the best weapon and that our countermeasures by means of a counter- rocket aimed at England should lead to a reduction in air raids on the Reich.

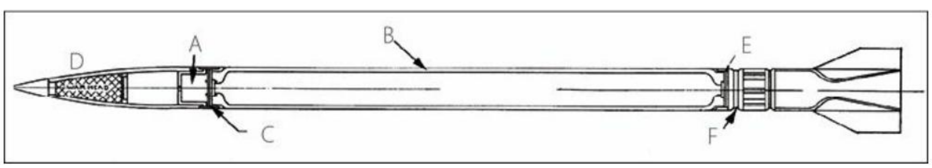
Even under the previously unrealized assumption that long-range missiles could be used in unlimited numbers and thereby actually cause the greatest destruction, this conclusion seems wrong against the background of previous experience. The opposite is true: after our rocket attacks on England, even the previous opponents of air terror against the German population will demand of their government [...] to intensify air terror against our densely populated areas to the highest degree, although we always counteract these attacks

are still practically helplessly exposed […] These considerations suggest that further air defenses and missiles of the C-2 *waterfall* type should be promoted. They are to be used immediately in the greatest possible numbers [...] In other words: every expert, every worker and every working hour that is expended in developing this program to the maximum will have a much greater influence on the outcome of the war than the efforts in favor of one any other program. Any delay in the implementation of this program may have consequences that will affect the outcome of the war.'"

The Typhoon

The *Taifun* is the second anti-aircraft missile developed in the EMW. The only thing she had in common with the *Wasserfall* was that it was powered by liquid fuel. It had no control system and was generally much simpler and smaller, reflecting the situation in which the German armaments industry found itself in the last stages of the war.

The *Taifun* represented an attempt to replace quality (a complicated guided missile) with quantity. It was to be fired by multiple rocket launchers in rapid bursts of 60 rockets each, exiting the ramp every 0.025 seconds. The ignition of a whole series (salvo) would take about 1.5 seconds.



The *Typhoon* F. (Fig.: CIOS) A = pyrotechnic charge; B = external fuel tank; C = membrane (torn apart at launch); D = warhead; E = membrane (torn apart at launch); F = fuel injector (injector).

Attempts were made to limit the impact spread as much as possible: the rockets were not only stabilized by control fins (i.e. the rear tail unit), but also by rotation. Spiral rails housed in the launch pad were used for this purpose. During flight, the rotational movement was achieved by the appropriate orientation of the

tail fins maintained. The *Typhoons launched* were supposed to form a zone where the probability of hitting the targets (bombers) would be very high. The tests carried out showed that the impact scattering of the rockets was actually very low, which made them e.g. B. at an altitude of 10,000 m created a destruction zone with a diameter of 250 meters, in which the probability of hitting a typical bomber was about 10-20%. The originator of this concept was General Dornberger, who headed the research facility of the land forces in Peenemünde.
In his honor, the multiple rocket launcher was given the code name *Dobgerät.*

It therefore seemed justified to use such a weapon as an alternative, e.g. B. to the complicated *waterfall rockets* to consider. Despite its simplicity and low manufacturing costs, the *Taifun* had one very significant disadvantage under the conditions of the time - it consumed large amounts of increasingly scarce raw materials, which was disproportionate to its effectiveness.

The *Taifun* was a classic rocket in appearance. The fuselage consisted of a steel tube with a diameter of 10 cm. The total length was 1.90 m and the launch weight was 19 kg, of which 10 kg was the fuel and 0.5 kg was the warhead. So a salvo of 60 rockets had a weight of 1,140 kg. Similar to the *waterfall rocket ,* the laboratories of the BMW company in

Munich were mainly responsible for the development of the fuel mixture and oxidizer and for determining the optimal ratio between the two substances. According to one of the scientists employed there (Dr. Hemmersath), no fewer than 6,000 different combinations were examined.

An innovation in the *Taifun,* resulting from its small size, was the replacement of the fuel pump with a simple gas generator that used the burning pyrotechnic charge. He pressed all the fuel into the combustion chamber within three seconds.
As a result, the rocket achieved an acceleration of 35 G at launch, which increased to around 60 G within a few seconds. The gas generator was installed in the front part of the rocket, just behind the warhead. Behind it were two containers for the fuel and the oxidizer. They consisted of two concentrically placed steel tubes (the

one tube was surrounded by the other tube). The outer tube, which also formed the fuselage frame, contained a hydrocarbon fuel mixture called "Tonka". The inner wall of this tube formed the second tube, which contained a mixture of acids known as "sage".

It was intended that the rockets would be manufactured mainly in the underground "Mittelwerk" near Nordhausen. In February 1945, the first order for 20,000 pieces was placed there. However, as prototype testing dragged on and the rocket was not actually ready for production, it was decided to quickly develop a simplified version with a solid propellant (for compressed powder) engine. This version, of which 50,000 were ordered, was given the designation *Taifun* P, and the original version was henceforth designated with the letter "F" to distinguish it. This "compromise rocket" was generally characterized by similar flight performance as the more complicated model. However, there was one exception: the *Taifun P* had a much larger impact spread, which of course had a negative impact on the possibilities of using this weapon (although in the existing situation it was a purely theoretical concept anyway). However, almost 20,000 of the *Taifun-P rockets* were made, 2,500 of them by early March and 15,000 by mid-April 1945. The *Taifun-F rocket ,* on the other hand, never left the production line.

It was not the only weapon of this class that was developed in the last years of the war. The *Taifun* 's main competitor was a light solid propellant rocket developed by the Henschel company - the *Föhn-73* (also known as the Hs-217). The projectile weighed only three kilograms and reached a flight altitude of eleven kilometers.
The 400 gram warhead was the equivalent of a medium caliber anti-aircraft artillery shell, but the accuracy of this weapon was much worse. The *Föhn-73* was designed to be fired from a maximum of 48 straight multiple rocket launchers. Despite bold plans, only 59 such launchers were built by the end of the war. The *Föhn-73* was intended as the basic armament for the simple Ba-394 rocket fighter made by Bachem *(Natter) .*

There were also other similar concepts, such as B. those with solid propellant

powered *June bug rocket,* or the TE-5, which was intended to run on liquid fuel. An interesting attempt was also made to develop an anti-aircraft equivalent of the famous *Panzerfaust* - it was a manual launcher for six unguided light rockets. On the battlefield, however, none of them played a role.

Post-war development in the field of military technology showed that the concept of unguided "surface-to-surface" missiles was completely wrong.[105,106,108]

Henschel Hs-117

The Hs-117, also known as the *Butterfly* (at times even given the informal designation V3, until it was discovered that this nomenclature was reserved for a multi-chamber gun), is another example of the peculiarities of this part of the German missile program. Similar to the *Wasserfall* or the R-1, this is a concept that has long been downright sabotaged - despite all rational considerations, Hitler had absolutely no understanding of defensive weapons.

On September 11, 1941, he gave the order to stop all work on guided anti-aircraft missiles. For the Third Reich, this decision had catastrophic consequences similar to the subsequent cessation of work on the Me-262 jet fighter. The fact that these weapons were built at all is simply a result of the fact that the decisions of the Führer were not implemented particularly conscientiously. Although the situation gradually changed in 1944 and the remote-controlled "surface-to-air missiles" were given higher priority, there was no longer enough time.

Just like her relatives, the *Schmetterling* was not practically completed until the surrender. It even went into serial production, but only after the war was practically lost. Most of these rockets never left the halls of the huge underground factory codenamed *Hydra* near Woffleben in the Harz Mountains - that's where they were found by American soldiers. The factory itself, by the way, was also far from complete.

The design of the Hs-117 was formally started in the spring of 1942, after the "Office for

Anti-aircraft missiles" was founded and a corresponding research program was established a month later. So the work started relatively early, and the plans for the uncompleted Hs-297 anti-aircraft missile were used when designing the later Hs-117 (it received this designation in the spring of 1943). Prof. Herbert Wagner from Henschel-Werke had already been working on their design in 1941 – until Hitler made the memorable decision mentioned, which blocked any work in this area.

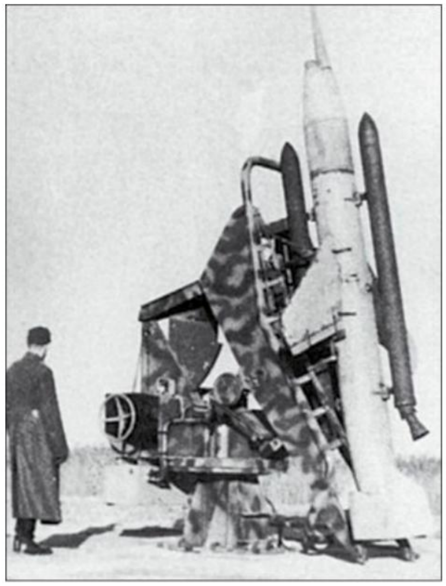
Test release of the Hs-117 from a bomber wing.
(Photo: Federal Archives)

Nevertheless, the *Schmetterling* is an almost classic example of a project that was not completed for organizational reasons, despite having the necessary technical knowledge and no doubt about the urgent need to start production of such a weapon (of which the bombardments of the Reich area clearly testified).

According to the first plans from the spring of 1943, the new missile should intercept targets at a maximum altitude of eight kilometers - its horizontal range should be up to 20 km. It was supposed to have a launch weight of 330 kg, although the warhead was supposed to weigh only five kilograms. A BMW engine for liquid fuel (nitric acid plus "Tonka" mixture) was to be used as the drive, which was to be supported by two start engines powered by pressed powder.

Eventually, these parameters were changed – the launch weight was increased to 440 kg, and the warhead weight to 25 kg. The *butterfly,* as planned in late 1944, could reach an altitude of 11,000 meters in about 60 seconds. It was 4.3 m long with a fuselage diameter of 33.5 cm and a wingspan of 1.98 m.

This data refers to the SI version.



The Hs-117C on a rocket launcher. (Photo: Federal Archives)

Although, as already mentioned, the preparations had already begun in 1941, it was not until September 1943 that there was a change in priorities that put the project on a more solid footing. However, this did not solve all the problems - it turned out that due to the previous blockage of work, the specialist team consisting of scientists, technicians and qualified workers had to be practically renewed. By the end of September only 100 people could be brought together, although 546 were considered the indispensable minimum. The raw material deliveries also looked different in reality than on paper. It was therefore impossible that the first launch of a rocket prototype could take place as planned, ie on January 1, 1944.

It was only on February 15th that a formal entry could be made about the start of a test. “Formally” because it was actually a structure that only looked like a *butterfly* on the outside . The rocket, which rose above the test site in Peenemünde, had neither the intended marching engine nor a guidance system. It wasn't even equipped with a warhead. The only drive formed two separable solid propellant engines. All missing components were still in the development phase.

Despite this precarious situation, the Air Force Ministry drafted in

May 1944 ambitious production plans: First, 265 pieces should be manufactured exclusively for research purposes, but the series production should include 24,500 (!) rockets. Soon these numbers were reduced to 200 experimental missiles and 23,650 combat missiles. Monthly production was supposed to be 3,000 pieces, although it was well known that this would not be possible until the second half of 1945. In addition to the Henschel company, the Askania, Bosch and Siemens companies were also to receive production orders.

Hs-117C shot down. (Photo: Federal Archives)

It was not until the summer of 1944 that the first examples with command-based radio control systems (which were based on a principle similar to that of the *fire lily)* were fired and dropped by He-111 bombers. This system relied on the good eyesight of the ground technician, so it could only be used effectively during the day and when visibility was good. Initially, the device mounted on board the rocket was codenamed *Colmar,* then it was renamed *Strassburg ,* and its ground counterpart was codenamed *Kehl.* However, the first versions were not convincing at all - the electron lamps used were extremely prone to defects and often faulty during assembly. It even happened that the devices installed in the missiles were missing or torn cables. dr
Sichling, a technician who operated one of the launch pads in Peenemünde, finally concluded that "It was a happy coincidence when a working rocket was placed in the launch pad, and himself at that

nor did it turn out that the steering system actually worked."

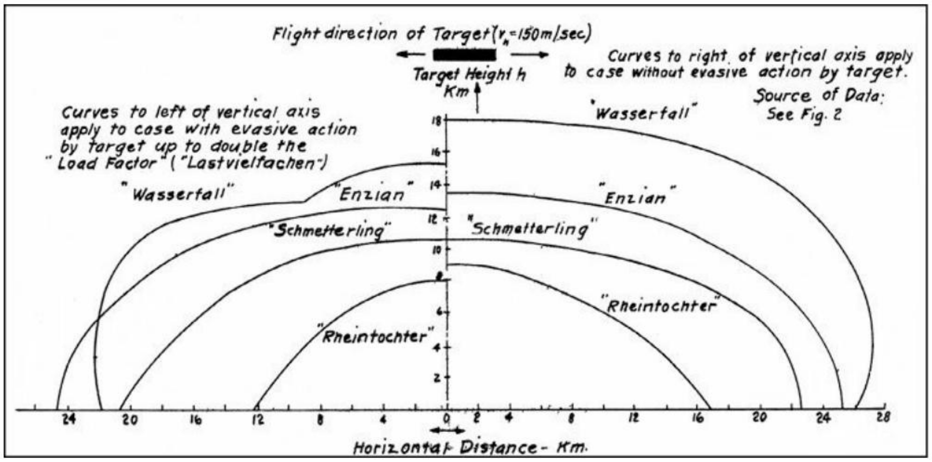
However, such exceptional cases did happen, and then the rocket behaved as expected - its aerodynamic characteristics did not bring any other unpleasant surprises.

However, the Hs-117 missiles still had no cruise engines. The first three copies with the proposed engine were completed only in early September (in the first rocket, the engine did not work at all, the other two had various defects). It turned out once again that this "unfortunate" project, which after all had been in development for several years, was still at a surprisingly early stage. In this situation, it would have been at least premature to try to force the production preparations.

It is a little-known fact that the Hs-117 was not only tested in Peenemünde - similar tests were also carried out in the occupied Polish territories, specifically at a test site code-named *Nord.* It was located next to the road between Mÿawa and Ciechanów (then Mielau and Zichenau) and occupied almost 300 km^2 . It was not only a military training ground, but also a perfectly prepared research complex on a fully developed site, with a developed road network, its own cinema and sports stadium, and buildings for 15,000-20,000 people.

In the spring of 1944, this facility was discovered by parachutists from the Soviet intelligence service, who, among other things, photographed "further versions of the *Butterfly rocket" (!).* Because of this, the "Sector 14A", where research work was taking place, was bombed a little later by the Soviet Air Forces.[114]

At that time, in November 1944, the first "series assembly facility" was already nearing completion. It was built in one of the tunnels of the Berlin U-Bahn (Sperling facility) and was initially intended to cover the needs of the center in Peenemünde - at that time production had not yet been relocated to the "Mittelwerk". In March 1945 the production capacity was to be increased to 150 rounds per month, and in November to 3,000.



A comparison of the planned parameters of anti-aircraft missiles as of March 1944. The range was shown in relation to the flight altitude (in kilometers). The right-hand side of the diagram refers to a situation where the target is not fleeing, while the left-hand side depicts the opposite situation. (Photo: CIOS)

Until the evacuation of the research center in Peenemünde, only 38 rockets were fired there from ground ramps, while 21 rockets were dropped from aircraft. Of that number (59), 28 attempts were "satisfactory" - less than half. At this stage, the program was stopped, although due to the “moment of inertia”, administrative decisions on its further development continued to be made.
On February 6, 1945 z. B. Himmler instructed SS-Obergruppenfuhrer Kammler (the SS had also taken control of this armament area) to develop the Hs-117H version with a camera remote control system - the technician was to observe the target in the final phase of the flight using a camera mounted in the nose of the missile was placed. It was planned to develop a special autonomous homing system (radar device?) by the end of 1945. In January of the same year, Prof. Wagner proposed a significantly modified rocket variant, codenamed *Project SII .*

In fact, there were two variants that were completely redesigned. They featured much better aerodynamics and had a much more “professional” look. Each variant had four, and not as before two additional solid propellant launch engines. As a result, both variants - the larger *SIIa* and the smaller, more compact *SIIb* - should have a higher speed

and achieve greater range (the analogy to the two variants of the *Wasserfall,* the W-5 and W-10, is obvious).

However, these were only paper concepts. Kammler's "armament staff" was not able to complete the development of the SI basic version anyway.

At the turn of January/February, the preparations for further tests with prototypes near Karlshagen were completed. By February 19, some Hs-117 missiles were being tested by dropping them from the He-111 bomber. The improved steering system *Kehl/ Strassburg* was examined. In the second half of March, the production of SI missiles at the *Hydra* underground factory should finally begin. It is estimated that a total of 150 of these rockets were made, about a third of which were left in the underground halls immediately after assembly as no cruise engines could be supplied for them. Fuel production also came to a halt.

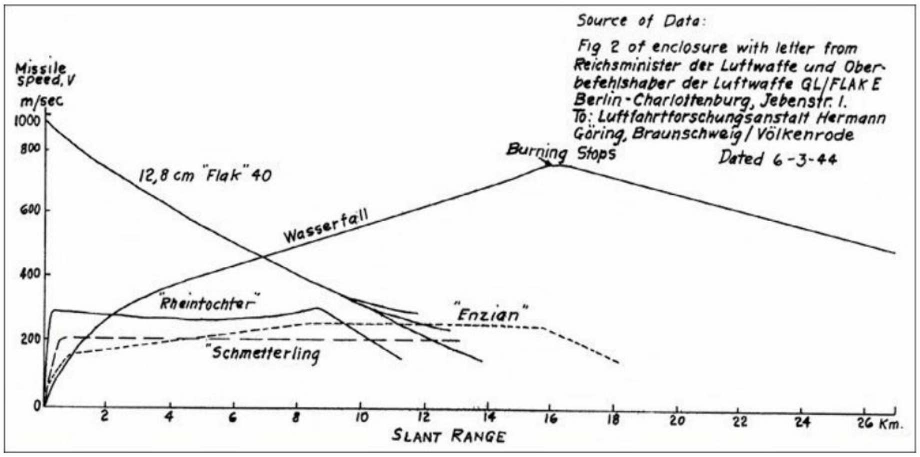
The fact that the *Schmetterling* was at the forefront of the German anti-aircraft missile defense plan is somewhat surprising. This plan, code-named *Vesuvius ,* was designed in 1944. The weapons of the discussed classes were divided into two groups. One group consisted of operative missiles - they were intended to form permanent defensive barriers that were used within the framework of the respective theater of war. The second group included tactical missiles designed to defend specific "points", e.g. B. from factories and airports.

The operational level was to consist of 1,200 W-10 *Waterfall missile* batteries (a total of 96,000 launchers!) and 1,300 *Butterfly* batteries. In early 1945, as part of these plans, the *Wasserfall* missiles were replaced with Taifun missiles. The tactical level, on the other hand, should be based on the *Enzian* and *Rheintochter* projectiles described below. 107,110,114

The Gentian

With the *gentian* we are dealing with a rather curious case, since the Construction of this surface-to-air missile very advanced

further development ..of a fighter aircraft, which was of course a rocket fighter, namely the Messerschmitt Me-163.
In addition, this construction was mostly made of wood.



The flight speed of the German surface-to-air missiles in relation to the range. This chart is largely based on estimates as it is dated March 6, 1944. (Photo: CIOS)

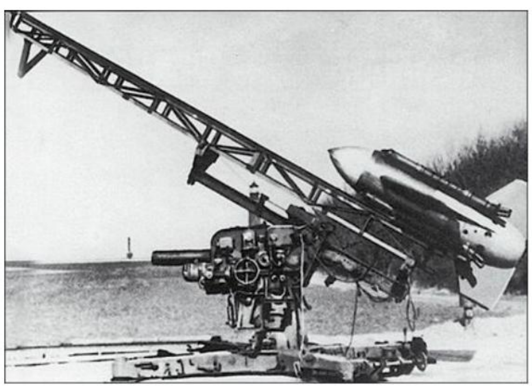
In its basic version (E-1), the *Enzian* was equipped with a guidance system that was used as standard in the rockets of this class at the time: the commands were given by a ground technician and transmitted to the missile by radio.

The first draft of this version was made in June 1943. Its main characteristics, based on the above-mentioned origin, included a high take-off weight of 1,900 kg and a subsonic flight speed of about 850 km/h. These parameters weighed the most heavily on the design and made it not particularly competitive. The designers therefore focused their main attention on overcoming such "hereditary burdens". From the start, the basic version was only treated as a transitional stage. The conception of improved development versions therefore lasted until the beginning of March 1945, when the realization of the project was stopped on the basis of an order from Kammler.

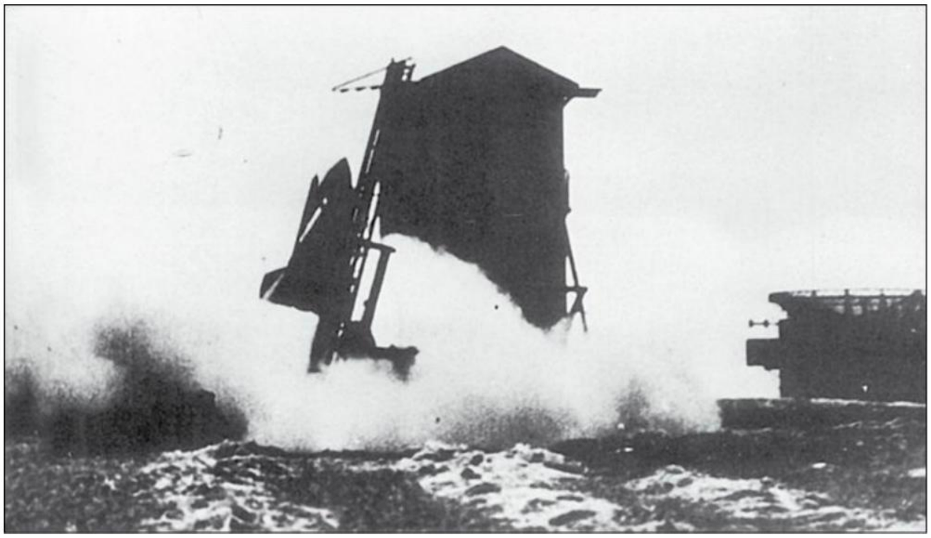
For almost the whole of 1944, work was carried out simultaneously in several directions - various aerodynamic systems were analyzed, while many electronic systems were designed in parallel

were intended to make the missile independent of ground personnel. These included the *Kehl/ Strassburg system* already mentioned (the first designation refers to the transmitter, the second to the receiver) and the *Kogge/ Brigg system, which was considered an interim solution.* Three alternative target search guidance systems were also developed specifically for the *Enzian ,* two of which worked passively. The first, which had been developed by the Viennese company Kepke, bore the code name *Madrid* and targeted heat sources (heat detector). This system included a mirror objective and a single (?) ELAC detector cooled to -80°C with liquid oxygen – so it should be relatively sensitive.
The second was an acoustic system codenamed *Archimedes,* in a sense a counterpart to the echo sounder on ships that arose in the works of AEG-Telefunken. The third solution, code -named *Moritz ,* was a semi-active direction finding system consisting of an impulse radar device designed to "illuminate" the target and a receiver on board the missile. The receiver in turn consisted of a receiving directional antenna and a control device that generated the commands for the control system.

The guidance system calculated the target position based on the deflection direction of the antenna and the time difference between the reception of the original signal and the echo - this enabled the distance to the target to be determined.

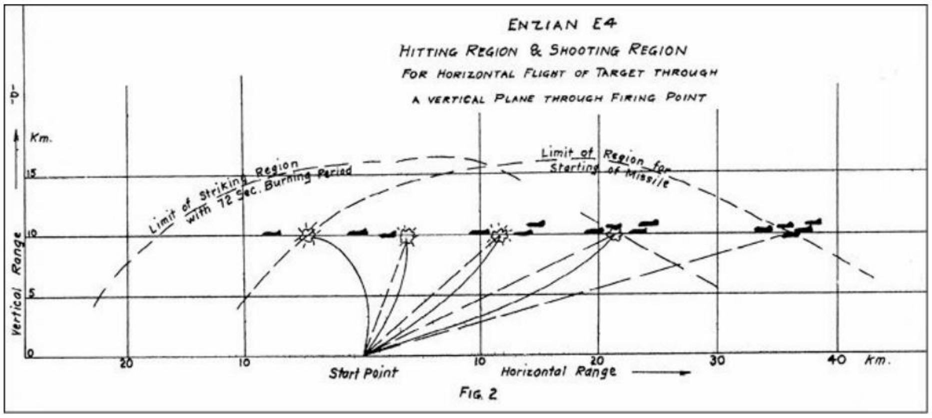


The *Enzian* E-4 on the launch pad. (Photo: Military Archives)



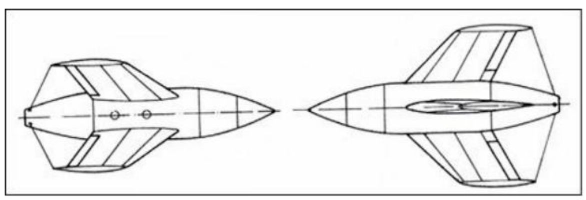
The *Enzian* E-4 being launched. (Photo: Federal Archives)

Simultaneously with the electronics, the design of the rocket itself and the engines (cruise engine and four launch engines) were also perfected. This work lasted practically the whole of 1944, so that Messerschmitt was only able to present the designs for the three versions, which the company considered mature, around the turn of the year 1944/45. These were the versions E-4, E-5 and E-6. The former was chosen for production, although it was the least different from the concept of the fighter pilot (which is probably the reason for the decision). In contrast to the E-4, the E-5 should be characterized by sophisticated aerodynamics for supersonic flight. The E-5 version was designed for a speed of Mach 2, while the E-4 version achieved a little less than Mach 1. With its slim profile and symmetrical delta fins, it looked like something from the future - in contrast to the E-4, which looked more like an unmanned aircraft. The better flight performance, including an increased range from 25 to 30 km, should mainly result from the improved aerodynamics and the further developed engine - the take-off weight and the weight of the fuel were almost the same.



The *Gentian* - the diagram shows the interception of the target. (Photo: CIOS)

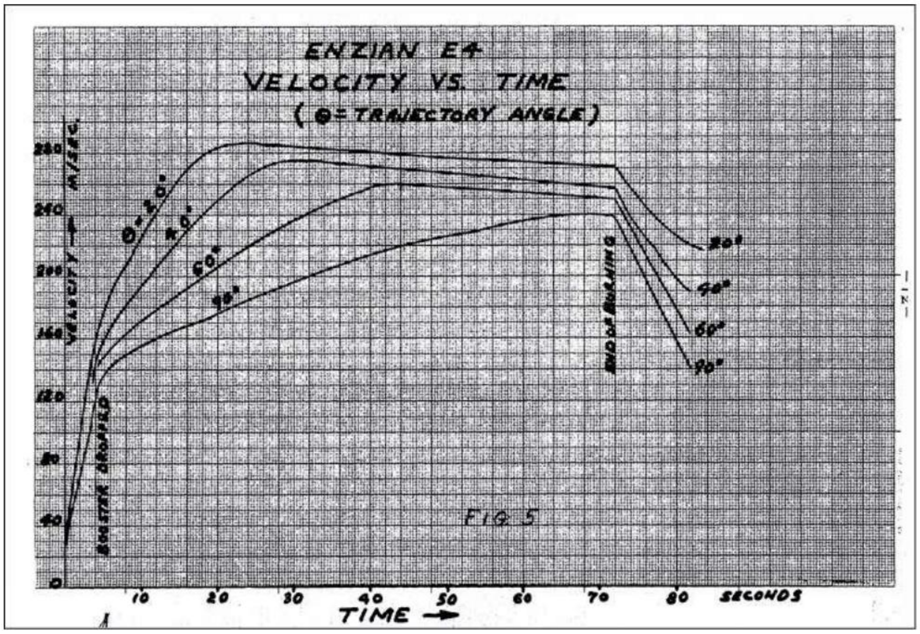
The E-6, the last of the three versions mentioned, was a concept for a guided "surface-to-surface" missile that was lighter than the V2. Similar to the E-5, this was an all-paper project.



The *Enzian* - the planned E-5 development version. (Drawing: M. Ryÿ)

The E-4, tentatively classified as ready for series production (tentatively, since none of the prototypes examined was fully equipped, although 24 were fired) was a missile that basically differed little from the targets that had been worked out as early as the summer of 1943 . Of course, a significant influence on this was the general situation of the Third Reich in 1944, the earlier erroneous decisions of Hitler blocking access to the latest technologies, but probably also too much scattering of work on anti-aircraft guided missiles.

Even under the existing political and organizational circumstances, the results would certainly be much more concrete if the Germans had concentrated on a single promising rocket type. These circumstances also meant that warheads with homing guidance in the case of the E-4 were relatively distant.

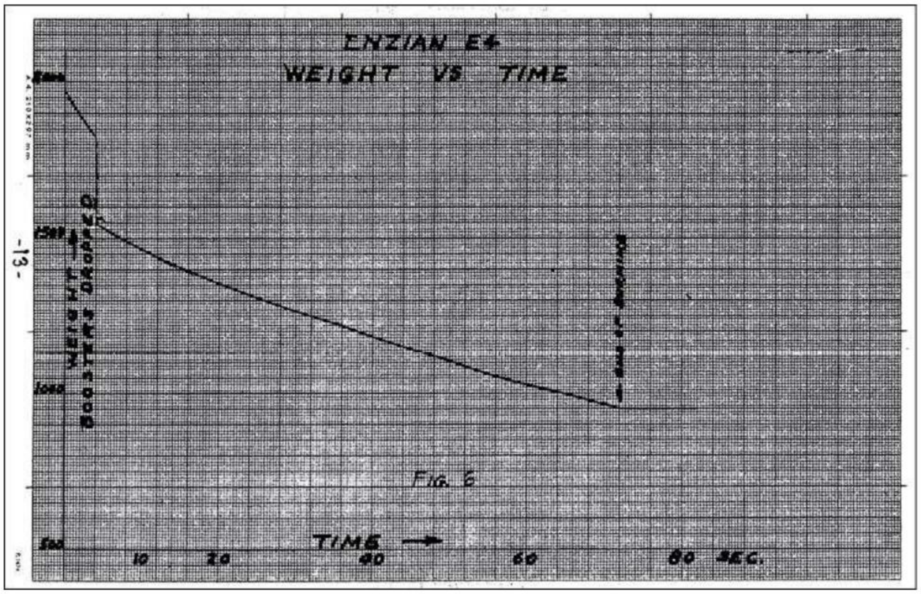


A diagram related to the E-4 version. The flight speed (y axis) was shown as a function of time. The individual curves correspond to different gradient angles. After five seconds, the launch engines were ejected, after 70 seconds the main engine stopped operating. (Photo: CIOS)

The E-4 could reach speeds of around 1,000 km/h, which wasn't much of an improvement over the E-1. Wood was also used for the construction of the E-4, which, unlike other raw materials, was plentiful: the rocket consisted of a total of 150 kg of wood and only 45 kg of steel (used mainly in the warhead). The FKF-613 liquid fuel engine was considered the simplest engine of this type ever used in a guided anti-aircraft missile. Immediately after launch it reached a maximum thrust of 2,000 kg, which dropped to about 1,000 kg after about 72 seconds. The take-off process was assisted by four solid propellant engines, which operated for four seconds and delivered a total thrust of 6,000 kg. The projectile had a 4.08 m long body with a diameter of 0.876 m, as well as two modified (mainly shortened)

Wings with a span of 4.05 m, which it "inherited" from the Me-163. It could intercept targets at a maximum altitude of 13,500 m.
The 225 kg warhead could theoretically destroy even group targets. However, with the limited thrust of the engine, such a heavy weight was perhaps too extravagant. Such considerations

were, however, purely theoretical anyway, since none of the Enzian rockets were ever used in combat. Work on this construction was interrupted in February 1945.

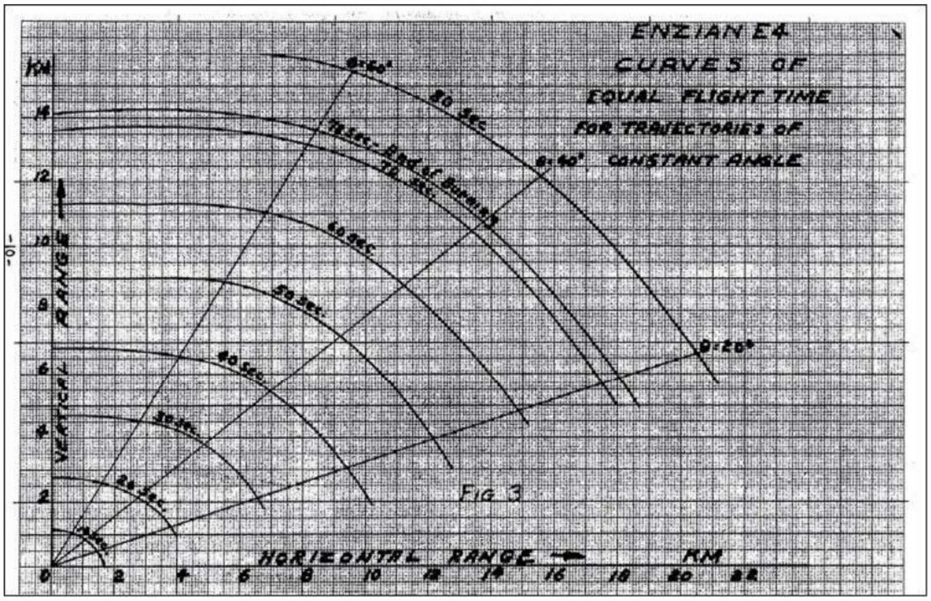


The weight of the E-4 bullet as a function of time - from the moment of ignition. (Photo: CIOS)

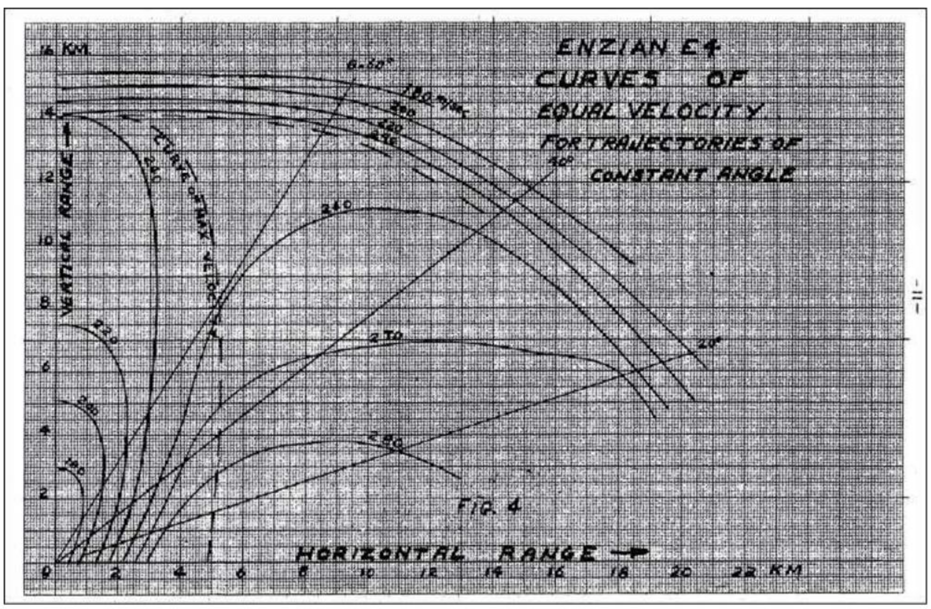
The *Enzian* was a rather peculiar rocket, based on a great many compromises and "hereditary bias". The version deemed suitable for production did not have a particularly good chance of success in combat. [102,106-7,109,111-2]

The Rhine daughter

The rocket described below represents probably the most successful design in the group of weapons discussed, which was developed in Germany at the time of the Second World War.



The *Enzian* E-4 - curves of the even flight time at a constant pitch angle. The x-axis corresponds to the range, the y-axis to the height. (Photo: CIOS)

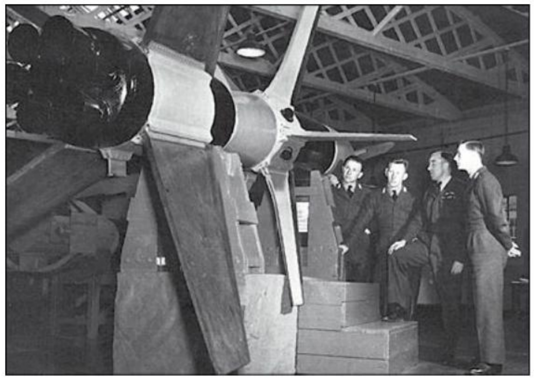


Constant airspeed curves under the same conditions as the previous diagram. (Photo: CIOS)

The roots of the development of the *Rhine subsidiary* go back to September 1942, when General Walter von Axthelm, Inspector General of the Anti-aircraft artillery, addressed the industry with a memorandum in which he offered to cover the cost of developing several projects in the area

to take over guided anti-aircraft missiles. One of the recipients of this memorandum was the Rheinmetall-Borsig company, which presented the preliminary design of its *Rheintochter projectile* in a record time of only about two months .

The Rheinmetall company had modest experience in the field of electronics, but the solution of related issues could be passed on to subcontractors, and such problems were basically limited to missile equipment, on which specialized firms and scientific research institutes were already working. The Rheinmetall company, on the other hand, had a different and – as it later turned out – decisive trump card in its hand. This company had a lot of experience in the design and manufacture of solid propellant rocket engines, which were also characterized by a remarkably high efficiency (at the same time as the *Rheintochter ,* the multi-stage ground-to-ground projectile called *Rheinbote was* developed, which despite its weight of 1.656 kg was powered exclusively by such engines). At the time it was a real sensation. Ensuring the required stability (ie, linearity) of powder combustion was a significant problem. Such substances are inherently unpredictable, especially for manufacturing practice and, of course, when the volume of the engine / combustion chamber is large. So if this company was able to build such a rocket much easier and cheaper than the competition, and faster at that, the road to success was much easier in the first place. It should be borne in mind that a typical liquid propellant engine consisted of several hundred parts, and the "combat success" of the rocket depended more or less on all of these components.



The R-1 in the factory. (photo from the author's collection)

Both stages of the *Rhine daughter* were each equipped with six cylindrical steel rocket engines. On the first stage, responsible for the launch process, these engines were relatively small: they only had to run for 0.6 seconds and their task was practically limited to accelerating the rocket on the launch pad. During this time they delivered a total thrust of 73.5 kN, ie 7.5 tons. The first stage was then jettisoned and the cruise engines fired, which lasted 2.5 seconds and delivered a much more powerful 24-ton thrust. In just three seconds from ignition, the rocket reached its maximum supersonic speed of 1,300 km/h. This means that during the most important part of its trajectory, the projectile rose solely by kinetic energy, without being propelled (the maximum flight altitude was 7,000 m with a range of up to 40 km). The version described had a launch weight of 1,750 kg, was 6.29 m long and had a 150 kg warhead. This version was given the designation R-1. Design work took over a year and a half, and the first prototypes were ready for flight tests by early summer 1944.

A total of several dozen pieces were delivered for trials. In the period between August and December 1944 they were fired from the Luftwaffe test site near Leba. The tests did not reveal any significant shortcomings. For this reason, the *Rheintochter* R-1 was technically ready for production by the end of 1944.

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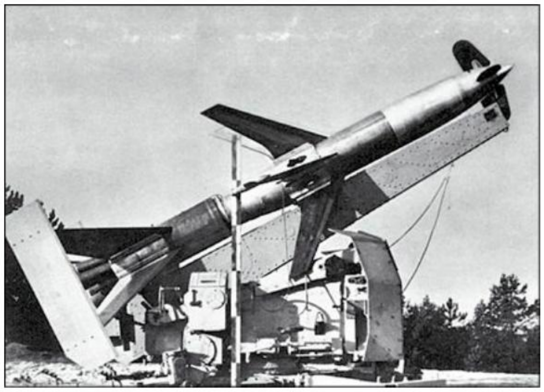
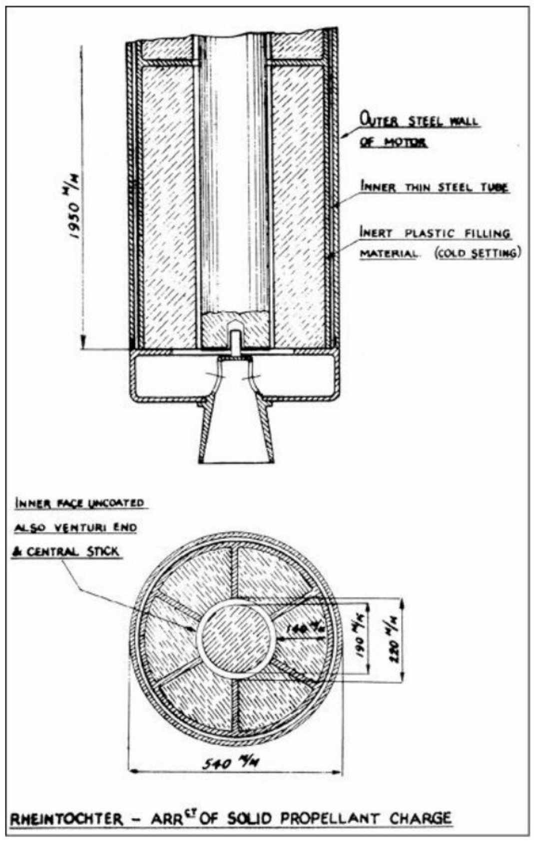


The Rheintochter R-1 on the launch pad.
(Photo: Military Archives)

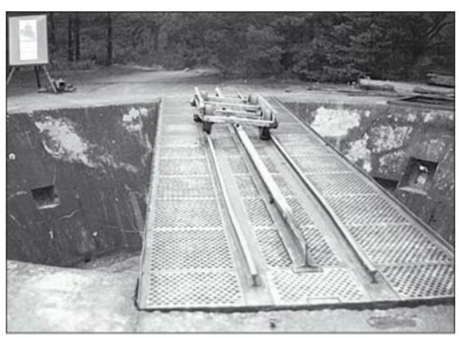


Cross-section of a rocket engine from the *Rhine daughter.*

The *Rheintochter* was equipped with a relatively simple steering system - the control commands were transmitted by radio from the ground. The radio receiver was located in the nose section of the rocket, just behind the servos controlling the aerodynamic rudders, which were placed at the very front of the nose. The warhead, on the other hand, was

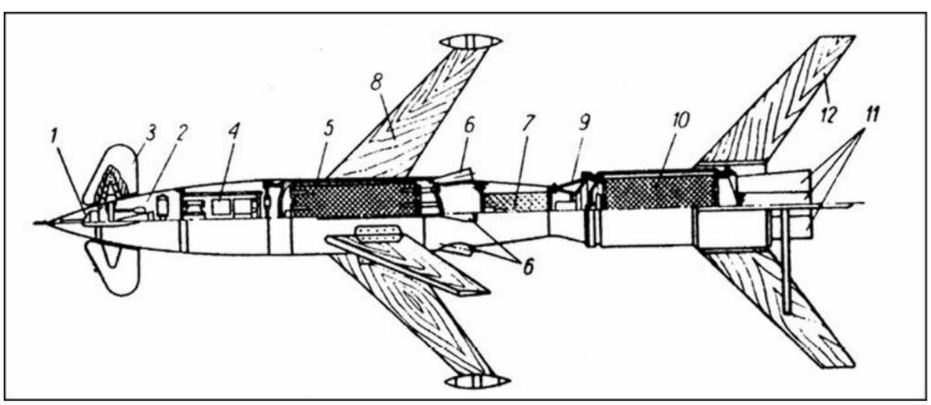
mounted aft of the second stage, ie behind the engines, whose outboard nozzles were mounted along the rocket body. In 1944, another modernized version of the *Rhine daughter ,* designated R-2, was developed. The first stage was omitted, instead this variant was equipped with four open rocket engines that were attached between the wings of the previous second stage and were ejected immediately after launch.

It was probably just an "experimental concept" designed to test the new configuration before developing yet another version (the R-3). The latter was outwardly similar to the R-2, but was to be fitted with a liquid-fuel cruise engine (however, this was never to be done and the existing later prototypes were powder-fired).



The remains of a Rheintochter rocket launcher on the test site near Leba. (Photos: I Witkowski)

The R-3 was generally slightly smaller than the R-1; eliminating the first stage and replacing it with additional side-mounted engines shortened the projectile from 6.29 to five meters. The launch weight was reduced to 1,500 kg, but the mass of the warhead remained unchanged. The final production version, powered by a Konrad liquid fuel engine, was intended to place 336 kg of an oxidizer (a mixture dubbed "Sage") and 90 kg of propellant (dubbed "Tonka") in the fuselage. The additional launch engines had a total weight of 173 kg.



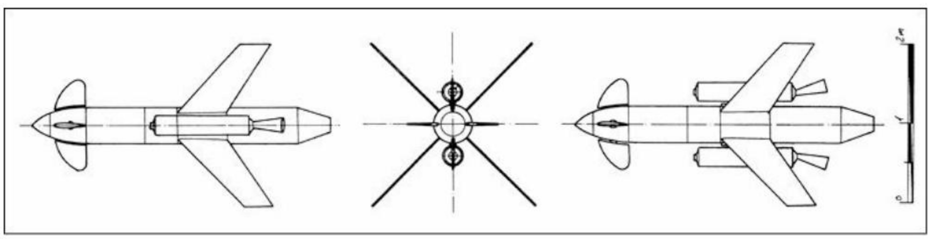
A construction drawing of the *Rhine daughter:*

1 = remote detonator; 2 = servo motor cell; 3 = air rudder; 4 = steering cell; 5 = with

Solid propellant powered main engine; 6 = thrusters main engine; 7 = explosive charge; 8 = wing; 9 = connecting ring between launch engine and main rocket; 10 = solid propellant rocket launch engine; 11 = thrusters of the launch engine; 12 = rear tail

As a result, the rocket should reach a maximum altitude of 14,700 m, which significantly exceeded the flight altitude of American and British bombers. However, the flight speed should be subsonic and not exceed 1,080 km/h. Most of the publications of the past years, which concern the German missile research program, give a certain place to the descriptions of the first combat missions of the *Rhine daughter*. The issue would not cause that controversy. In a footnote to an otherwise very good article on the subject that appeared in 1999,

[107] However, the following can be read:



The concept of the R-3 variant. (Drawing: M. Ryÿ)

"According to older sources, production of the R-1 and R-3 versions of the *Rheintochter began at the end of 1944.* Some of them were even supposed to be tested by anti-aircraft artillery units in combat conditions. In January and February 1945, these missiles were able to prove their effectiveness against American bombers.

At that time, 82 R-1 and 88 R-3 shells were fired. Of the R-1 rounds, no fewer than 51 were said to have hit the target, and of the R-3 rounds only five missed the target! However, some of the sources contain conflicting information about the effectiveness of the missiles: according to them, only eight R-3 shells hit the target. However, all of this information should be viewed with the greatest skepticism. The latest investigations indicate that the *Rheintochter* rockets were only fired as part of proving ground tests.

They neither went into production nor were they delivered to the units

delivered."

It is only regrettable that the author of the footnote refrained from citing a source. This information, while calling into question the previous statements, does not provide a satisfactory answer either. 101:106-7

The adder

The Natter missile is considered a special type of anti-aircraft missile, although it was operated by a pilot. However, the Germans classified them as Flakrakete and not as an airplane, which, incidentally, was more accurate given their nature. This weapon was very reminiscent of the Japanese Kamikaze missile *Ohka* and was probably its predecessor.

The *Natter* was deemed suitable for production after the Germans compared it to a number of other competing models, including the Heinkel-designed *Julia missile aircraft,* the Junkers *Walli* and the Messerschmitt P-1104. All had a similar engine, but were inferior to the *Natter* in terms of flight performance. The similarly designed manned Eber projectile designed by the DFS was also not popular. It was intended to be launched from the wing of a flying bomber and carried no armament. Its job was simply to ram the tail of an enemy bomber (the structure was reinforced accordingly) or spear into it. For a similar task, the Bv-40 glider from the Blohm and Voss company was modified. Its counterparts included the Zeppelin Rammer aircraft (air-to-air missile) and Messerschmitt's Me-328. A variant of the latter with folding wings was even designed - it was intended to be used as an anti-aircraft weapon on submarines. These weapons did not go into production, and not only because of the difficult situation of the industry. Its military usefulness was in doubt, however, there were objections and controversies about the semi-suicidal character of this armament.

The *Natter* was examined more closely after the war and described, among other things, in the aforementioned (notably excellent) technical analysis of German weapons by W. Kozakiewicz. 102 Here are some excerpts:

"Ba-349 A. The first production version of the *Natter* was powered by Walter's HWK 109-509A engine and reached a top speed of 880 km per hour. She rose at a vertical speed of 10.8 km per minute and reached an altitude of 14.7 km. The hull was made of wood; the construction had stiffening battens forming a plywood-clad skeleton and consisted of two main parts. The pilot was in the rear, just behind the main armament, which consisted of high-explosive rockets. They were built into a square or hexagonal frame (depending on the rocket caliber). The whole thing, along with the frame, was in a plexiglass head attached to the fuselage of the aircraft with explosive bolts. In order to increase the aircraft's firepower , two MK-108 30mm cannons were mounted on some manufactured aircraft types in addition to the typical armament, which consisted of 33 R4 high-explosive rocket shells and 24 73mm *Föhn rockets* respectively.

To protect the pilot, there was a solid cover in front and behind him, as well as two armored walls. The cockpit sides and the fuselage section intended for the fuel tank were protected with a 3/16" armored jacket. This armor, combined with the *Natter* 's narrow frontal area and high speed , made the aircraft inaccessible to bombers' defensive armaments. The control device was operated by the pedals, the throttle control and the autopilot device acting on There were two push buttons on the front dashboard. One fired the

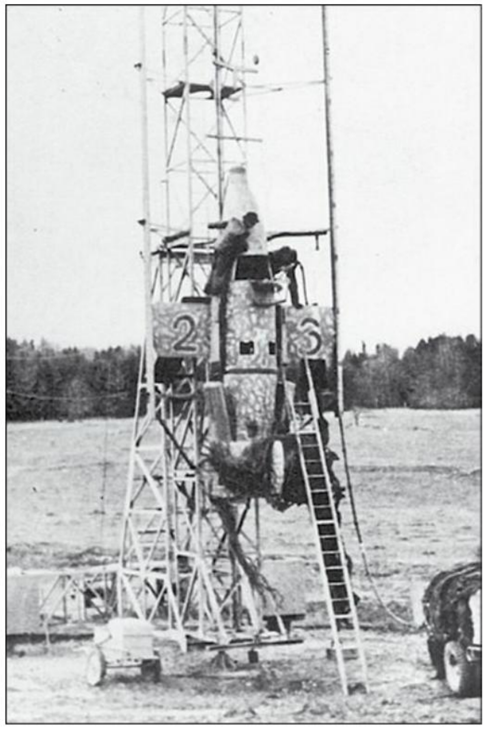
A *snake* found by the Americans . (Photo: NARA)

To facilitate decoupling of the aircraft part, a hand lever was installed. At the rear of the cockpit were two fuel tanks, one (upper) for 190 liters of 'C-Stoff', the second (lower) with a capacity of 415 liters for 'T-Stoff'. Viewed from the nose of the aircraft, the parachute box can be seen on the left side of the fuselage, and on the right the turbine pumps and the supply and auxiliaries of Walter's HWK 509A-1 dual-propellant engine. The engine itself was centrally installed and occupied the rear part of the fuselage. The short-span wings were permanently attached to the fuselage and consisted of individual plate-shaped wooden spars that passed through the fuel tanks and wooden ribs.

The wing tips were protected by shielding metal plates. There were no ailerons in the wings. The aircraft tail consisted of the rear stabilizer and rudders mounted above and below the fuselage. The horizontal stabilizer was placed above the center line of the fuselage; in it were ailerons, which were operated by means of a control gear. To improve control, the aileron control rods were fitted with the

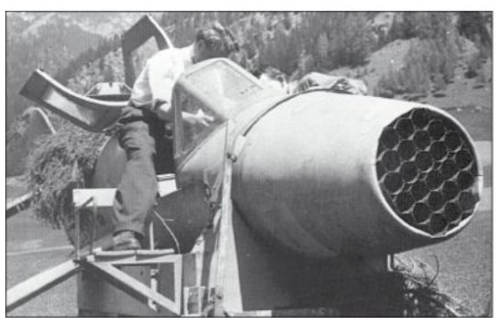
fins connected to the rocket nozzle, which were flown around by the exhaust jet and steered it accordingly. As a result, improved response to all longitudinal and lateral aircraft movements was achieved, and the violent reactions of the steering fins controlled by the autopilot device were offset by the action of the ailerons. The same method was also used with the V2 rocket projectile during the tests carried out in Peenemünde.

Die *Natter:* As you can see, getting started was a bit difficult. (photo from the author's collection)



The *Natter* during launch preparations. (Photo: Federal Archives)

The introduction of this process to the Natter aircraft undoubtedly contributed to their improvement and increased stability.
The components that made up the *Natter* 's fuselage are unknown.



The *Adder* with highly visible rocket launchers. (Photo: Federal Archives)

The aircraft was launched from an almost vertical ramp. The necessary thrust was generated by ATO solid propellant rockets, which were attached to the tail end of the fuselage. The launch ramp was 24 m high. Four ATO rocket units worked for six seconds, delivering a thrust of

500 kg each. Later Schmidding 553 rockets were used, which produced 1,000 kg of thrust for twelve seconds. In the final stage, the BP-20 prototype used these units exclusively. The initial acceleration was higher than 2 g, with the launch rockets being ejected at an altitude of 1.5 km in full load operation of the dual-fuel main engine. It was possible to rotate the launcher in the vertical plane so that it could be placed in a horizontal position, allowing the *Natter* to be loaded from the transport vehicle onto the ramp. The aircraft's wingtips and tail fin were guided along the launch pad's guide rails. When enemy aircraft approached, a signal was given, after which the pilot climbed into the cockpit. The missile was rotated along with the ramp and positioned in the direction of the approaching bomber squadron. The bombers' course was transmitted and controlled by radar, and their attitude was sent to the autopilot receiver by an electrical connection which was broken on takeoff. Soon after takeoff, the aircraft was automatically aligned on the set course until the pilot took over the trajectory correction himself, as the bombers were able to change course after realizing the plane was shot down. The course of the bombers was radioed to the pilot by the ground station, which enabled him to quickly adjust the direction of flight. After getting close to the bombers, the pilot fired the entire explosive rocket charge, which caused his machine to experience recoil from the exhaust jet. A whole series of these shells reached the center of the bomber formation and destroyed it with fire, air blasts and fragments.

After the pilot operated the lever that separated the nose section of the aircraft from the fuselage, the machine was subjected to severe exhaust and air blasts. During this time, he could easily come under fire, but a second pull of the lever catapulted him out of the plane. Within two seconds, the parachute opened independently and the pilot slowly fell to his feet

down the earth. At the same time, the rear part of the fuselage, which contained the engine and equipment, was also severed and fell to the ground on its own parachute. […]

Due to the easy launch pad, the Natter rocket could be fired from any location, even a little isolated, e.g. B. a city park, a factory site or the positions of the field artillery.

The use of these missiles against enemy air squadrons raised hopes that the situation of German air defense could be improved. However, the bombing of the production facilities, workshops and assembly plants made it impossible for the Germans to use the Natter projectiles en masse."

Technical details of the ***adder***

Wing span:	5.486m
Length: Lifting	6.50m
surface of the wings: 5 m	^{2}
Total weight: 2,200 kg Lifting	surface
loading: 440 kg/m Maximu	m speed:^{2}
1,000 km/h Climb rate: 11	275 m/min
Flight time: 2 min	

Air-to-Air Missiles

The company Henschel Flugzeugwerke AG from Berlin-Schoenefeld, which began to develop the first missile of this type in 1941, is considered a pioneer of German research in the field of air-to-air missiles.

It was the Hs-117H - a further development of a surface-to-air projectile that was only available in its mature form in the final months of the war. Similar to the rest of the concepts, the Hs-117H did not see combat use. In this case, the Germans were limited to just 20 test firings, made by a Dornier Do-217 bomber, with six missiles hitting the target. It was a single-stage missile that still had a range of seven miles

achieved – the largest in this weapon group. Similar to the case of the other shells, its primary purpose was to destroy enemy bombers, that is, large and slow-moving targets. The Hs 117H was one of many types of weapons designed to stem the devastating mass air raids of the American and British Air Forces.

In order to accomplish this task as quickly as possible, the Germans made certain changes to the already proven *Butterfly* (Hs-117A) surface-to-air missile. The additional solid propellant launch engines were dispensed with. Engineers also attempted to replace the engine, which ran on cumbersome and dangerous liquid fuel (58.6 kg of oxidizer SV and 12.4 kg of RZ fuel), with one designed to run on pressed powder and thus would make the rocket fuel systems on airfields superfluous. This would also mean that the projectiles would always be ready for action. However, this plan had to be discarded, as it turned out that the powder engine was obviously still unfinished.

The missile was controlled by commands sent over the radio path by the carrier aircraft. It was also intended to develop an interference-free cable routing system.

In the basic version, the warhead contained 36 kg of explosive mixture 643-BS, which was probably initiated by a proximity fuse. It was also planned to use warheads with 60 and 100 kg of explosives, which should serve to destroy group targets, e.g. B. the "dense" enemy bomber formations.

The first examples of the Hs-117H, which were from the first short production series, were delivered to the Luftwaffe in January 1945.

Almost simultaneously with the rocket described above, Prof. Wagner developed another air-to-air projectile in the Henschel works - the Hs-298. It was smaller and featured a much simpler rocket engine powered by solid propellant based on diethylene glycol, but was significantly inferior to the other designs. The first launch attempts on December 22, 1944 by a

Junkers-88 were carried out, evidenced its low effectiveness. Of the three missiles fired, only one destroyed the target.

In the short time that was left to improve the design, it was not possible to increase the effectiveness of the Hs-298, which is why the Luftwaffe did not show any serious interest in this missile. A major reason for the projectile's modest performance was the unfinished, seven-kilogram *Kakadu proximity fuze,* which was very vulnerable to the vibrations caused by the engine.

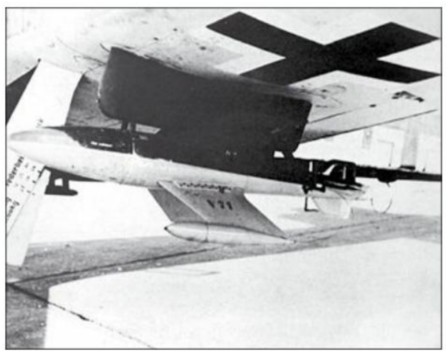
Much better was the X-4 round, developed in 1942-44 by Dr. Max Kramer had been developed in the Ruhrstahl-AG-Werke and on which the Germans placed their greatest hopes. It was also the first guided air-to-air missile to go into mass production, although, as noted, it never saw combat use.

The good reputation of the X-4 was mainly the result of using a successful and very combined simultaneously innovative remote control system.

For the most important part of its trajectory, the missile was guided by commands transmitted through a cable guidance system. After the firing signal, two powder charges ruptured the membrane that sealed the compressed air tank and the engine inlet (the compressed air tank was responsible for injecting the fuel). The "Tonka-250" fuel, a mixture of amine-based organic substances, was mixed with the oxidizer (concentrated nitric acid to which four to five percent ferric chloride was added as a catalyst), causing auto-ignition in the combustion chamber. This ensured an initial thrust of 150 kg, which fell to 33 kg after 35 seconds of flight – just before the engine stopped operating. After the missile left the launch pad, flares attached to the end of two of the four wooden fins (allowing the technician to visually track the missile) were fired. The cables for command transmission were rolled up by means of two larger containers, which were located at the end of the other wings. They were each 5.5 km long and 0.2 mm in diameter. When the missile was close to the target, control was taken over by the homing system, which aimed the missile at the sound source (the bomber engines). In this way, a sufficiently high

Precision can be achieved over a relatively large distance.
An innovation was the use of fuel tanks in the form of two tubes made of light alloys, twisted like two thick feathers in the central part of the fuselage. One end was connected to the pressurized gas tanks, the other led into the engine combustion chamber.

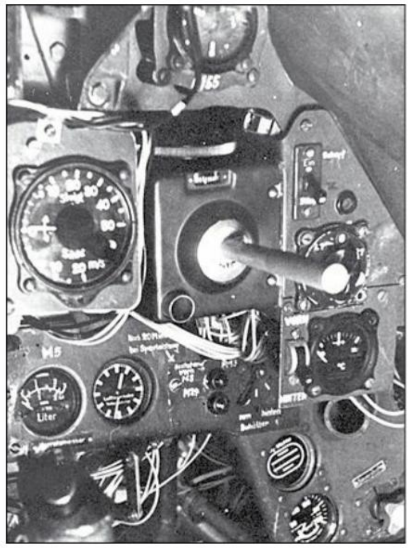
The complete drive system was the work of designers from BMW. Although this system was the source of the biggest problems, BMW management decided to develop a new, completely proprietary projectile based on it. Kramer meanwhile planned to replace the BMW engine with a new solid propellant engine. However, it never came to that.



The X-4 shell under the wing of the FW-190 fighter. (Photo: Federal Archives)

A total of 100 X-4s were made - this lot was intended to implement a flight test program initiated in late 1944.

The tests showed that the hit probability was very high - the warhead detonated on average seven meters in front of the bomber.
The use of 20 kg of plastic explosive based on nitropenta and housed in a steel case 10 mm thick ensured the complete destruction of the target in such conditions. An explosion 15 m away caused serious damage.
The Fw-190 fighter pilots in particular were to be armed with the X-4 projectiles.



A "joystick" for controlling the projectile, installed in the cockpit of a fighter plane. (NARA)

The fourth type of rocket developed in Germany – the above-mentioned BMW projectile, which received the designation "Device 3378" – was outwardly very similar to the Kramer projectile. It was created in two versions, each 1,540 and 1,690 mm long. Although a total of no fewer than 1,540 of these rockets had been manufactured, a number of unresolved issues meant their future prospects were bleak.
Aside from the unfinished engine, which was to be replaced by solid-fuel propulsion (which was never done), engineers were unable to agree on a definitive homing procedure by the end of the war. Sound systems, optical systems and other solutions have been studied; however, the end of the war interrupted this work. In addition, the insufficient number of combat aircraft and the lack of fuel were the main problems.

The missiles from BMW were defeated by the X-4. On February 6, 1945, the decision was made to mass-produce the latter in the Ruhrstahlpresswerke in Brackwede near Bielefeld.

A sample of the X-4 intercepted by the Americans. (Photos: I. Witkowski)

Tactical and technical details of the most important radio-controlled air-to-air projectiles

	Hs-117H	**Hs-298**	**X-4**
length (m)	3.7	2.0	2.0
wingspan (m)	2.0	1.29	0.725
Total weight (kg)	260	95	60.5
hull diameter (m)	0.35 0.205 0.222 143		
Engine weight (kg)	26 22.7		
Explosive weight (kg)	40	25 20	
Maximum flight speed (m/s) 250		234 248	
Range (km) 11		1.6	5.5

Air-to-surface and surface-to-surface missiles

In addition to the projectiles of the "V" series, which were described in the first part of the book, many smaller remote-controlled weapons were also developed in the Third Reich. Let's start with the aircraft armament

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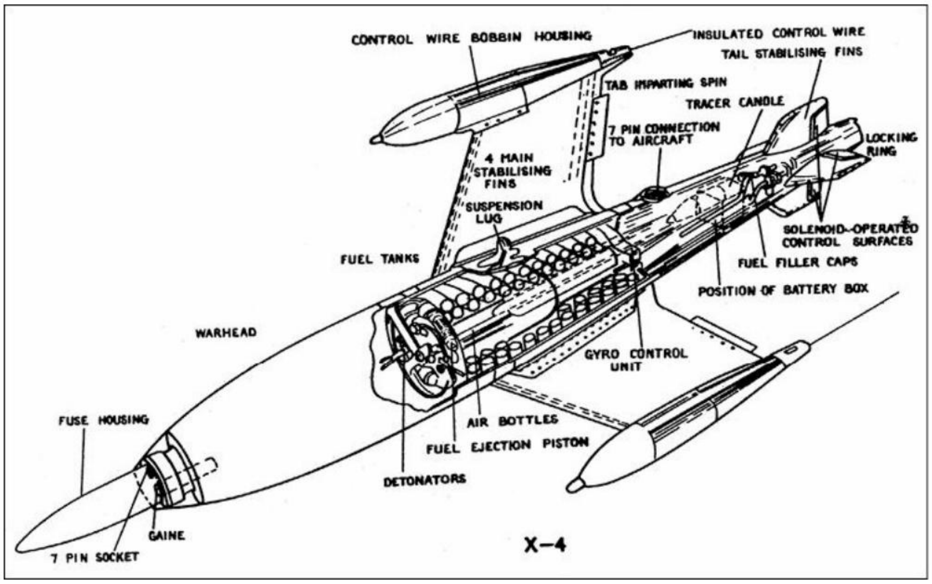


The construction scheme of the X-4. (NARA)

In this area, too, the Henschel company from Berlin played first fiddle. The most important weapon was clearly the Hs-293 projectile, which had been developed under the direction of Prof. Herbert Wagner and was built in many versions. Initially it was supposed to be a guided bomb; however, after adding a rocket engine, the Hs-293 became a "normal" guided missile. The standard version with the suffix "A" went into mass production and was undoubtedly the most important German guided missile from a military point of view. It went into series production as early as November 1941 and caused the greatest losses among the Allies. The total tonnage of the ships sunk alone was 440,000 tons. In combat conditions, the bullet was characterized by a relatively high hit probability of about 45% (90% on the test site). A total of 1,900 Hs-293A were made. The missiles first saw action on August 25, 1943 in Bay of Biscay. They were mainly used to attack ships, since if they hit the target accurately, even a single large-caliber missile could easily destroy them.

The basis of this design was to be an upgraded conventional SC-500 bomb weighing 603 kg

represent, which contained 295 kg of a powerful explosive. She became the warhead of the missile. The production version of the A-1 was operated remotely by a technician on board an aircraft - the commands were transmitted by radio. Soon after being fired, the projectile developed a top speed of almost 900 km/h, which gradually dropped to around 560 km/h as the plane continued to fly. It dived over the target, making it significantly more difficult to launch. About half a second after impact (in the case of a ship, after penetrating the ship's deck) the fuse detonated a trialen charge - the most powerful explosive used during World War II, composed of hexogen, TNT and aluminum dust, the latter increasing the explosive heat. The missile was powered by Walter's HWK 109-507 engine, which was suspended under the main fuselage. The engine weighed 134 kg (of which 66 kg was liquid fuel) and delivered 590 kg of thrust for 10 seconds. In addition, five pyrotechnic flares were ignited at launch, which burned for 100-110 seconds and made it much easier for the technician to track the projectile, especially at night.

This peculiar mission concept of the Hs-293A led to a fundamental problem: if the trajectory was not congruent with the line between the aircraft and the target, the missile had to be remotely guided as well. This placed great demands on the skills of the technician. The experience of the operating personnel played an important role.

Since this missile was used on a relatively large scale, some examples of its combat use can be given: The first "heavy" air raid on a large formation of enemy ships (67 units in total) took place on November 21, 1943. 22 long-range heavy bombers from Type He-177 *Greif* and Fw-200 *Condor* involved. A total of 18 Hs-293A missiles were deployed, sinking a freighter weighing 4,500 tons and severely damaging a second weighing 6,080 tons. Four He-177 aircraft were lost in the process. Despite the small dimensions of the missiles, anti-aircraft guns shot down one of them and

damaged another, resulting in changing its trajectory.

The Hs-293A shell mounted under the wing of the Do-217 bomber. (photo from the author's collection)

A somewhat smaller air raid took place almost two months earlier: on September 30, the Corsican port of Ajaccio was attacked. This attack was not entirely successful either: seven of the eleven Do-217 bombers did not return to the base - but only one ship was destroyed.
To make matters worse, two projectiles went into gliding flight and "washed down" in the harbor area. They later fell into enemy hands almost undamaged. The Luftwaffe had a little better luck on the Aegean Sea, where the Hs-293A missiles had sunk or severely damaged seven destroyers before the end of 1943.

Based on this experience, the design of the bullet was perfected - in 1944 several new versions were developed. Since there had been interference with the control signals, the Germans primarily concentrated on alternative remote control systems.

Soon the first (and only) batch of 200 pieces of the Hs-293 in version B went into production. The only innovation was the transmission of commands via cable. For this purpose, two coils, each with 16 – 20 km of cable, were mounted on the projectile; in addition to this, 12 km of cables were coiled from the aircraft on board. This variant was very accurate - the average hit deviation was only five meters for a well-trained technician. In one of the tests, twelve missiles were fired in a circle 25 meters in diameter - all missiles hit the target.

After that, version C was developed, but it no longer went into series production and was not included in the arsenal. Only one lot of about 60 pieces was delivered, the

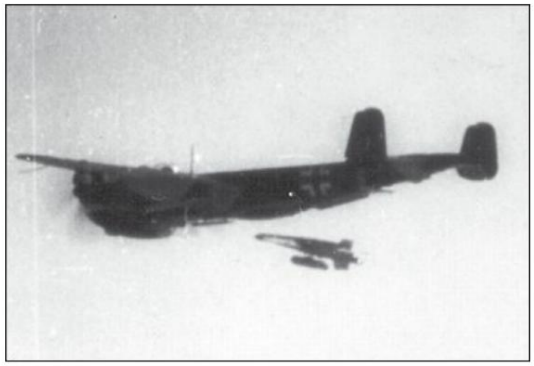
have been tested. The only difference compared to the Hs-293B was the use of a warhead derived from the Hs 294 shell described below, which was intended to hit the ship below the waterline while in level flight. potentially the most groundbreaking, albeit unfinished, further development the of the Hs-293 was the D version. It was equipped with a video guidance system as with the other shells. A video camera with a lens featuring a field of view of 25° was placed in the nose part. The installation of the camera made it necessary to lengthen the hull by no less than 748 mm.

In addition, an antenna was mounted at the rear on attachments that were previously intended for the flares, which transmitted the image from the warhead to the aircraft. With the first variant of the camera *(Ton-1)* , target detection was possible only on the final section of the trajectory, ie from about 3,800 meters, of course only during the day and in good weather conditions.

This version, still in need of improvement, was tested in the autumn of 1943 on a test site near a lake near Stargard, where the first detonations took place. The tests revealed the low effectiveness of the projectile. It also turned out to be problematic to keep the rocket on its trajectory in the initial phase. Despite minor improvements, the Hs-293D was a weapon that was far from ready for combat use. During another series of tests, which was carried out in Jesau near Königsbrück in April 1944, only one of twelve projectiles hit the target directly, all the others missed it by 80 - 100 meters.

Soon after, a new, much better camera called *Tonne-2* was developed, which practically doubled the resolution from 224 to 441 lines. However, the greatest advance did not come until August 1944 when the *Tonne 4a camera* was introduced.

In total, about 250 Hs-293D missiles were mass-produced, but they never entered the arsenal. During further work on this projectile, the engineers encountered difficulties that were due to Hitler's order to concentrate armaments production; nevertheless, some newer versions emerged.



A further development of the Hs-293 - the anti-ship missile Hs-294. (Photo: Military Archives)

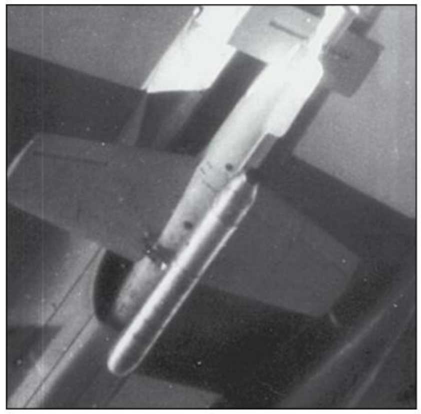
The larger dimensions of the projectile made it necessary to use a more powerful drive. This is how the G version came about, which was powered by the WASAG 109-512 powder motor with a thrust of 1,200 kg (instead of the previous 590 kg). However, it was controlled directly via radio. In version H, the video system in version D was used; it was powered by the Schmidding 109-513 liquid fuel engine, which used concentrated nitric acid as the oxidizer. This engine delivered a maximum thrust of about 1,000 kg.

There were also prototypes of two development versions, which were renamed Hs 295 and Hs-296. The first had a huge warhead weighing 1,260 kg and was designed to destroy large and particularly important targets. The second prototype was a modified Hs-293 H shell and was fitted with a camera based on the latest technologies. This from Dr. Rombusch from the Physics Institute in Dressenfeld weighed only 2.5 kg (!).

Due to its combat use, the Hs-293 was the most important radio-guided aircraft weapon developed at the time of World War II.

Significantly, it was considered one of the trump cards of the dying Third Reich. Therefore, at the end of the war, it (or any documentation pertaining to it) was to be taken out of reach of the Allies as part of a secret and until now little-known operation.

This maneuver was aimed at securing the most important German resources.



The Hs-293A. (Photo: USAF)

Data on the development versions of this weapon were therefore transferred to the "Instituto de Investigaciones Cientificas y Technicas de las Fuerzas Armadas" in Argentina, where work continued and resulted in the fact that in 1958 a shell based on the design of the Hs-293 was was included in the arsenal of the armed forces there.

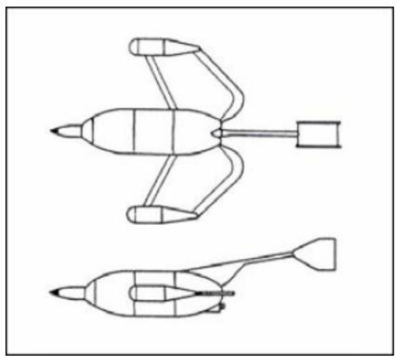
The Hs-293 also ended up in Russian hands and became the basis for the development of the Szczuka missiles.

It is a little-known fact that the Germans also developed "air-to-air variants" designed to destroy bomber formations and to be carried by Ar-234 and Do-217 K-2/U-1 aircraft. One of these was equipped with the thermal Hamburg system with target search guidance and the *Pinscher* proximity fuze . The 105.115 Es work on these Hs-293 versions was not completed. It is estimated that around 1,900 Hs-293s of all versions were manufactured during the Third Reich.

A technical advance similar to that of the Hs-293 occurred in the Third Reich during the development of the world's first anti-tank guided missile. The concept of the first weapon of this type, called *Little Red Riding Hood ,* originated in the DVC under the direction of the aforementioned Dr. Kramer in 1943. It was better known as the X-7. It was a light projectile weighing 9.08 kg with a range of about 2.4 km, powered by a two-stage (launch and cruise) solid propellant engine using diethylene glycol as the fuel. The first version was controlled by radio commands, with the production version the

However, control commands are transmitted by two cables. They were unwound from drums mounted on the wingtips. A modified hollow charge grenade weighing 2.5 kg and having a diameter of 140 mm was used as the warhead, which made it possible to penetrate 200 mm thick steel armor. Only a test batch of around 300 pieces was made - plans to start series production in Brackwede and Neubrandenburg were destroyed by the end of the war. It was intended to produce ground ramps for the X-7, which would be operated by two soldiers. Aircraft ramps for Fw-190 aircraft were also planned.

101,116



The anti-tank guided missile *Little Red Riding Hood.*

At the same time, the team led by Dr. Kluge, who worked in the research laboratory of the AEG-Telefunken concern, developed a related projectile with similar dimensions to the X-7, but which was distinguished by the innovative way of transmitting commands using light signals.

This bullet was called *Rumpelstiltskin .* Although an experimental batch of about 100 rockets was produced, very little information is available about this weapon.

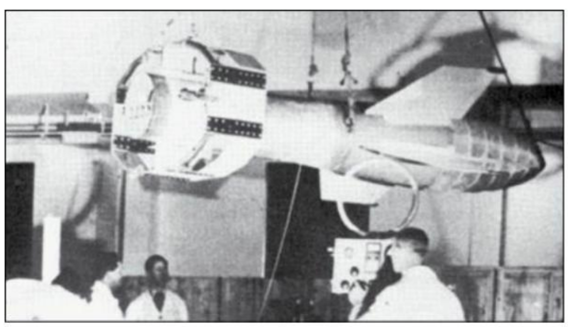
Tactical and technical details

	Hs-293A-1	**Hs-293D X-7**	
length (m)	3.58	4.35 0.765	0.47
hull width (m)	0.47	0.14 9.08	2.5
Takeoff weight (kg)	975	1,040	
Warhead weight (kg)	603	508	
Explosive weight (kg)	295	… …	
Maximum Airspeed (m/s)	265	about 170	about 100
Range (km)	about 6	about 10	about 2.4

Guided Bombs

Several types of guided bombs also emerged in Germany during the war, two of which deserve special attention: the PC-1400X *(Fritz-X)* and the BV-246. The former was often used successfully in combat. Its production began in 1943. It weighed 1,570 kg and was primarily intended to combat ships, which are relatively small, maneuverable and often armored targets and therefore difficult to destroy in any other way. In the standard version, the *Fritz-X* was controlled by radio commands, but in the event of a malfunction, you could also use a cable that was unwound from the bomb.

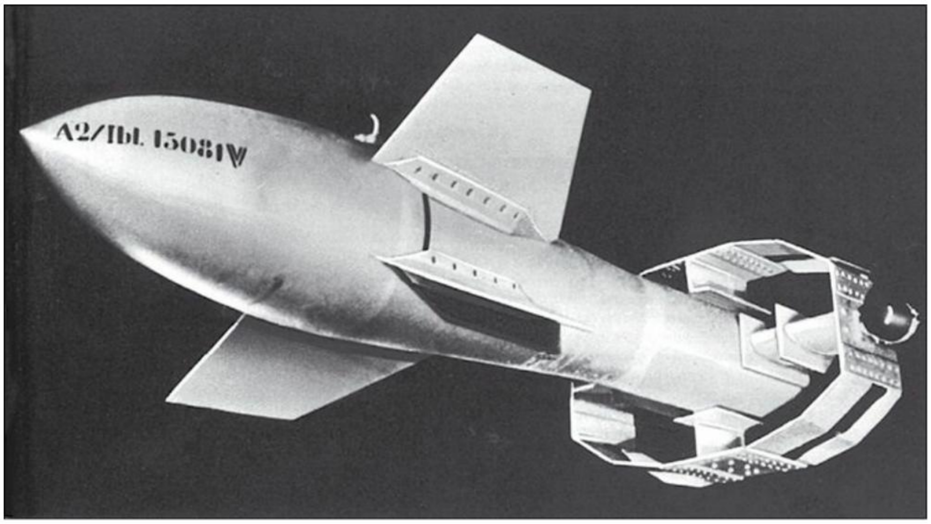
The baptism of fire took place in the summer of 1943: after the capitulation of Italy, on September 9, the Do-217 aircraft from the KG-100 regiment sank the Italian armored cruiser “Roma” with these bombs; the twin ship "Italia" was badly damaged. During the Allied landings in Sicily, the armored cruiser "Warspite" and the three cruisers "Uganda", "Philadelphia" and "Savannah" were seriously damaged.

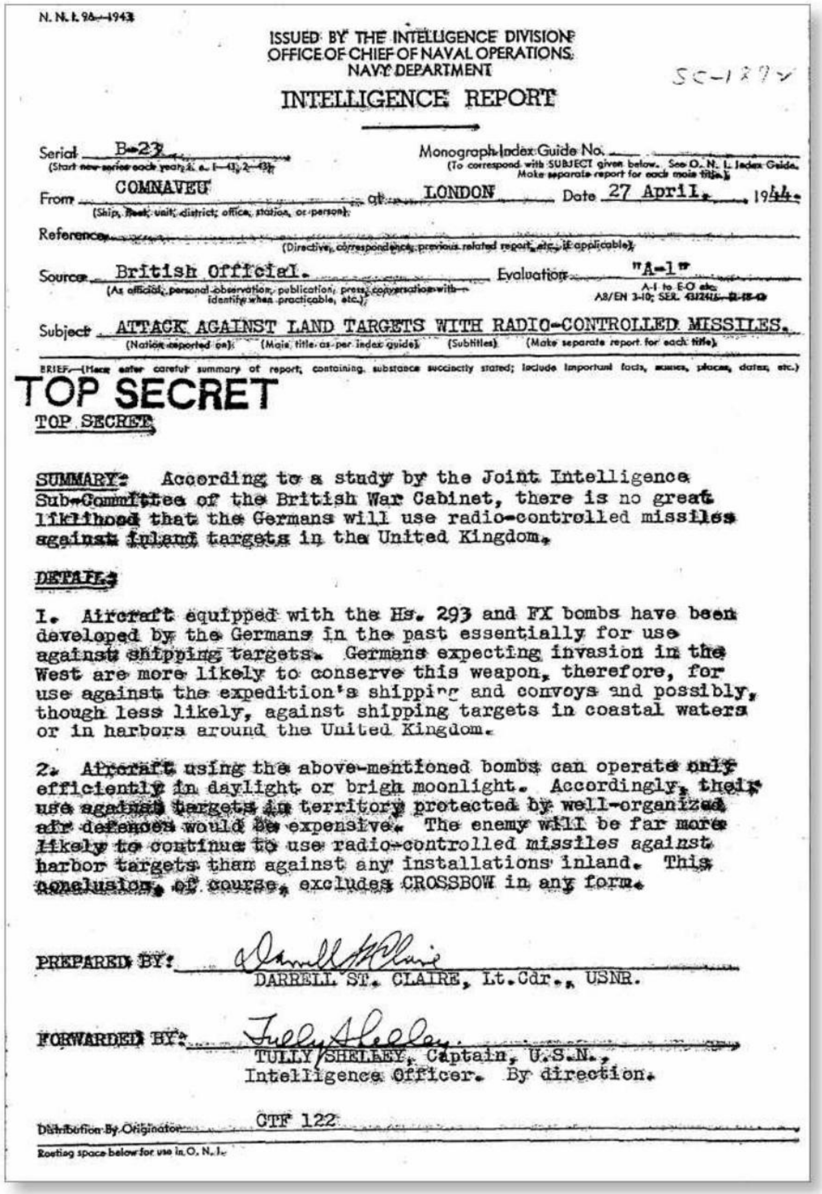


The remote control bomb PC-1400X/Fritz-X. (Photos from the author's collection)

At the same time, two more modern versions with homing guidance were developed: one reacted to radio/radar beams (ZSG *Radieschen),* the other to heat sources (ZSG *Offen).* It is known that the former version was tested in August 1944 at the Leba Luftwaffe test site. The target was a transmitter with a power of 500 W - two dropped bombs fell at a distance of about 30 meters from the device. The "anti-radar version" was intended to enable the destruction of the British network of radio direction finding stations used by Allied bomber squadrons

allow navigation. The version with the thermal system was intended to destroy the British steelworks. That plan almost came to fruition. 115





N. N. I. 96—1943

ISSUED BY THE INTELLIGENCE DIVISION
OFFICE OF CHIEF OF NAVAL OPERATIONS
NAVY DEPARTMENT

SC-1397

INTELLIGENCE REPORT

Serial B-23 (Start new series each year; i. e. 1—43, 2—43)

Monograph Index Guide No. (To correspond with SUBJECT given below. See O. N. I. Index Guide. Make separate report for each main title.)

From COMNAVEU (Ship, fleet, unit, district, office, station, or person) at LONDON Date 27 April, 1944.

Reference (Directive, correspondence, previous related report, etc., if applicable)

Source British Official. (As official, personal observation, publication, press, conversation with—identify when practicable, etc.)

Evaluation "A-1" (A-1 to E-O etc. A8/EN 3-10; SER. 4312416—12-18-42)

Subject ATTACK AGAINST LAND TARGETS WITH RADIO-CONTROLLED MISSILES. (Nation reported on) (Main title as per index guide) (Subtitles) (Make separate report for each title)

BRIEF.—(Here enter careful summary of report, containing substance succinctly stated; include important facts, names, places, dates, etc.)

TOP SECRET

TOP SECRET

SUMMARY: According to a study by the Joint Intelligence Sub-Committee of the British War Cabinet, there is no great likelihood that the Germans will use radio-controlled missiles against inland targets in the United Kingdom.

DETAILS:

1. Aircraft equipped with the Hs. 293 and FX bombs have been developed by the Germans in the past essentially for use against shipping targets. Germans expecting invasion in the West are more likely to conserve this weapon, therefore, for use against the expedition's shipping and convoys and possibly, though less likely, against shipping targets in coastal waters or in harbors around the United Kingdom.

2. Aircraft using the above-mentioned bombs can operate only efficiently in daylight or brigh moonlight. Accordingly, their use against targets in territory protected by well-organized air defenses would be expensive. The enemy will be far more likely to continue to use radio-controlled missiles against harbor targets than against any installations inland. This conclusion, of course, excludes CROSSBOW in any form.

PREPARED BY: DARRELL ST. CLAIRE, Lt.Cdr., USNR.

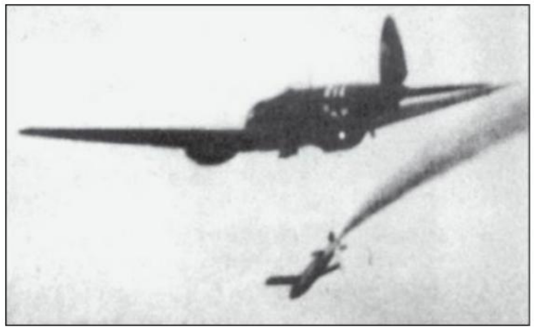
FORWARDED BY: TULLY SHELLEY, Captain, U.S.N., Intelligence Officer. By direction.

Distribution By Originator: CTF 122

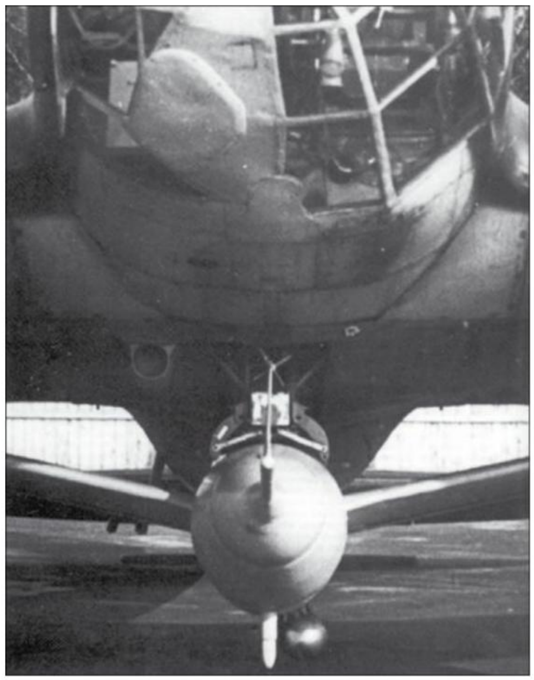
Routing space below for use in O. N. I.

An April 1944 American intelligence document discussing the use of guided bombs and air-to-surface missiles by the Germans as a possible countermeasure against the Normandy invasion. (NARA)

Another interesting construction was the BV-246 remote-controlled bomb, alias *Hagelkorn.* Thanks to their particularly streamlined shape and unusually long wings with a wingspan of over six meters, their range was up to 200 km!



Dropping the BV-246 guided bomb. (Photo: Federal Archives)



The BV-143 guided bomb. (Photo: Federal Archives)

So from that point of view it was similar to the V1. Of course, such a long range precluded any command control. The first version of the BV-246 was only equipped with a gyroscope autopilot and, with an impact spread of 10 - 20 km, was only suitable for attacking area targets such as e.g. B. Cities; it was not suitable for point targets. The warhead weighed 500 kg, similar to the V1. While an attempt was made to incorporate the Hs-293D's tonne cameras, engineers aimed to use passive seeker guidance systems (the same as on the *Fritz-X)* as well as the retinal thermal system, which, after reaching the target area, fires the fuse would initiate. Also in

In this case, the British and Soviet smelters and mills were considered the main targets. However, there was no longer enough time for series production of the bomb.

Although the guided bombs described in the preceding pages represented only a small part of the German research effort in the field of guided missiles, they do illustrate the magnitude of the technical and military breakthrough that occurred as a result of the development of guided missile systems and homing solutions.

The large number of these weapons makes one thing clear: it wasn't long before Hitler had a war tool in his arsenal that would at least have forced the other side to reassess their warfare methods. In short, if the development of the guided missiles presented in this chapter had taken place without the obstacles imposed from above and the useless competition of the "V" weapons, the war would certainly have been different.

This complex of topics is of such great importance that I took the liberty of describing the steering systems in more detail on the following pages - all the more so since the sources (documents) I used are not generally known. 8,82,104,112-3 So here is a brief synopsis of the most interesting concepts. I would like to start with a group that has already been partially described.

Target seekers for heat sources

Such systems were, of course, derivatives of the heat detectors that began to be developed in the early 1930s. In most cases their construction was based on semiconductor detectors using a sulphur-lead compound.

Neither of these systems ever "saw" an Allied aircraft, although development of some types was virtually complete. Not all of them were intended for surface-to-air missiles, by the way. The first arose z. B. with regard to "exploding boats", which should be a kind of surface equivalent to torpedoes. They were intended as fast, armored motorboats designed to engage enemy landing forces or ships in port. Such a weapon was used by the Germans

already at the Allied landings in Normandy, although at that time it was still piloted by a diver, who aimed the motorboat at the target, then jumped into the water and returned swimming. At that time, however, "automatic" variants with homing systems were already being designed.

In this context, two thermal management systems with the aliases *Tasso* and *Linse emerged,* the latter representing a further development of the former. The devices were developed in the Berlin works of the Gema company with the participation of the companies CPVA (Danish-Nienhof), AEG (Berlin) and Elac (Kiel).

Tasso, the older of the systems on which work had stopped in 1943, was relatively simple, if only because, unlike a rocket, the field of view could only be scanned in one plane, along the horizon. The lens system developed in 1944 was more complicated in that it used the “Schwarzschild phase comparison method” to select the target signal. So the signal has undergone some processing first.

The optical system had a diameter of only 50 mm (mirror lens objective). Of course, such miniaturization had certain advantages. However, the small lens diameter meant that only a small amount of radiation could be captured, which of course affected the target detection range; nevertheless, this disadvantage could be partially offset by the enormous size of the targets.

In the fall of 1944, the finished system could be tested on the captured minelayer "Studebaker" with a water displacement of 600 tons (i.e. a relatively small unit). The ship was spotted at a distance of two kilometers. As a result, it was determined that in combat conditions, the automatic guidance system should be put into operation at a distance of about 1,000 m from the target. Before that, the planing boat (which reached a speed of 126 km/h!) was to be controlled by commands transmitted via a two-channel radio system. The main explosive charge should be placed under the hull, ie below the water surface, and detached from the hull just before hitting the target.

I. JEŹDŹCY TORPEDOWI
I KIEROWCY ŁODZI WYBUCHOWYCH

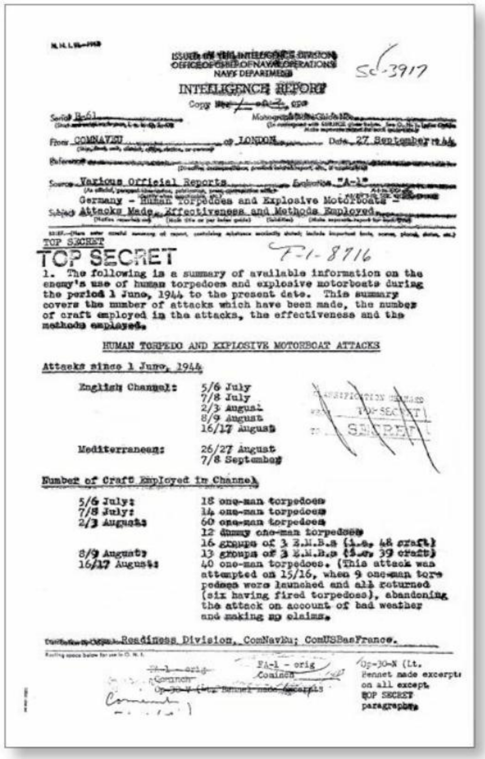
Łódź wybuchowa z siedzeniem odrzutowym

A page of *Signal* magazine with an article about the Linse boat.

The *Negro.*

The Tietjens shipyard in Potsdam developed a special type of boat for the Linse system (which was also known under the alias *Teichlinse),* which was characterized by exceptionally stable handling.
Still, there was no doubt that the new weapon would only be effective in calm seas. The main limitation was that

the lens had a relatively small field of view of only 3°. There was simply a risk that the system would “lose sight” of the target, although this problem was not as important as it seemed at first glance. In fact, the lens was only responsible for course correction in the final phase of the "journey", ie during the 20-30 seconds before impact.



ISSUED BY THE INTELLIGENCE DIVISION
OFFICE OF CHIEF OF NAVAL OPERATIONS
NAVY DEPARTMENT

SC-3917

INTELLIGENCE REPORT

Serial B-61

From COMNAVEU at LONDON Date 27 September 1944

Source Various Official Reports Evaluation "A-1"

Subject Germany - Human Torpedoes and Explosive Motorboats - Attacks Made, Effectiveness and Methods Employed.

TOP SECRET

TOP SECRET F-1-8716

1. The following is a summary of available information on the enemy's use of human torpedoes and explosive motorboats during the period 1 June, 1944 to the present date. This summary covers the number of attacks which have been made, the number of craft employed in the attacks, the effectiveness and the methods employed.

HUMAN TORPEDO AND EXPLOSIVE MOTORBOAT ATTACKS

Attacks since 1 June, 1944

English Channel:	5/6 July 7/8 July 2/3 August 8/9 August 16/17 August
Mediterranean:	26/27 August 7/8 September

CLASSIFICATION CHANGED TO TOP SECRET ~~SECRET~~

Number of Craft Employed in Channel

5/6 July:	18 one-man torpedoes
7/8 July:	14 one-man torpedoes
2/3 August:	60 one-man torpedoes 12 dummy one-man torpedoes 16 groups of 3 E.M.B.s (i.e. 48 craft)
8/9 August:	13 groups of 3 E.M.B.s (i.e. 39 craft)
16/17 August:	40 one-man torpedoes. (This attack was attempted on 15/16, when 9 one-man torpedoes were launched and all returned (six having fired torpedoes), abandoning the attack on account of bad weather and making no claims.

Readiness Division, ComNavEu; ComUSBasFrance.

~~FA-1 - orig~~
~~Cominch~~
~~Op-30-N (Lt. Bennet made excerpts~~

FA-1 - orig
Cominch

Op-30-N (Lt. Bennet made excerpts on all except TOP SECRET paragraphs

A US intelligence document with statistics of attacks made by the Linse boat and "live" Negro torpedoes. (NARA)

A single 8 mm detector from Elac was used in the lens system.

The next solution to be presented is already based on the principle of a classic thermal conduction system that was intended for rockets. These are various variants of a device that was known under the code name *Hamburg* , developed one after the other in the laboratories of the Elac company .

The first of these variants, designated *Hamburg I* , featured an unusually large 30mm detector located in the focus

of a mirror with a diameter of 25 cm. In this case, the entire mirror acted as the scanning element, spiraling around the entire field of view, which had a diameter of 60° with a beam width (resolution) of 10°. The tests carried out showed that these values were not sufficient in the case of anti-aircraft missiles (including the *Wasserfall type) .* Therefore, the authorities specified their specifications for possible future modifications: The requirement was made to increase the target detection range to two to five kilometers and the resolution (i.e. the guidance precision) by half a degree. according to dr Kutscher, who led the work, would be able to meet these requirements provided that the optical system was completely rebuilt and a more complex scanning method, similar to the *Kiel* III system, was used.
However, work in this area was not completed.

Instead, a scaled-down version of the *Hamburg* I system, designated *Hamburg II ,* was developed, replacing the sulfur detector with a corresponding cesium oxide detector. The lens of the *Hamburg* II system had a diameter of 14 cm, which was practically the only advantage over the older variant. The device was still not suitable for use in anti-aircraft missiles, but successfully coped with its task on "less demanding" targets, e.g.
B. in ships. This solution was intended for remote-controlled sea target glide bombs. In order to be able to carry out tests, ten prototypes were ordered, of which only two could be delivered and examined before the end of the war. One of them was installed in the nose part of an airplane flying in the area of the Bay of Gdaÿsk.

The first result of these flights was the recognition of the need to incorporate stabilization of the optical system in the warhead. At this time, however, the acts of war led to the interruption of the work.

The situation was similar for other comparable solutions, although much less information is available about them.

However, the following types are known to have been worked on: 103,112-3

1. *Emden* - a rocket and bomb solution jointly developed by the Elac and AEG companies. She was an alternative to

Hamburg II system. However, none of the prototypes were completed.

2. A similar system was developed by the small company Kepke from Vienna. It is known to have been given the alias *Madrid* and was considered to equip the Enzian missiles and BV-296 glide bombs. The system used a detector manufactured by Elac.

3. Little is also known about the Armin-2 solution, which was certainly the most modern system created during World War II. Its main designer was the aforementioned Dr. Coachmen from the Elac Laboratories in Namslau. Why was this solution the most modern? She was the first to fully deserve the name thermal imaging system, imaging the thermal image of the target. An intelligence analysis mentions that "their development could almost be completed" - the system worked, but had an insufficient range for the He-111 bomber of about 1.2-1.5 km.

4. The Kepke company developed a large (as it later turned out to be too large) automatic guidance system with a lens diameter of 28 cm. Fifty prototypes were delivered for trials, but the system never went into mass production. The advantage of the large diameter was the impressive target detection range of about three kilometers in the case of a typical bomber.
5. Several concepts of such systems were secretly developed at the AEG works. All that is known is that they were given the aliases *Aries, Retina* and *Cancer* .
6. An interesting and successful system called the *glowworm* was developed in the Breslau branch of Rheinmetall-Werke. There were two versions, differing in the type of detector (in both cases they were from the Elac company) and the field of view, which was three to eight degrees wide. The detector used helical scanning. In 1944, 50 test prototypes were delivered. The system weighed only three kilograms. Information about the range is missing.

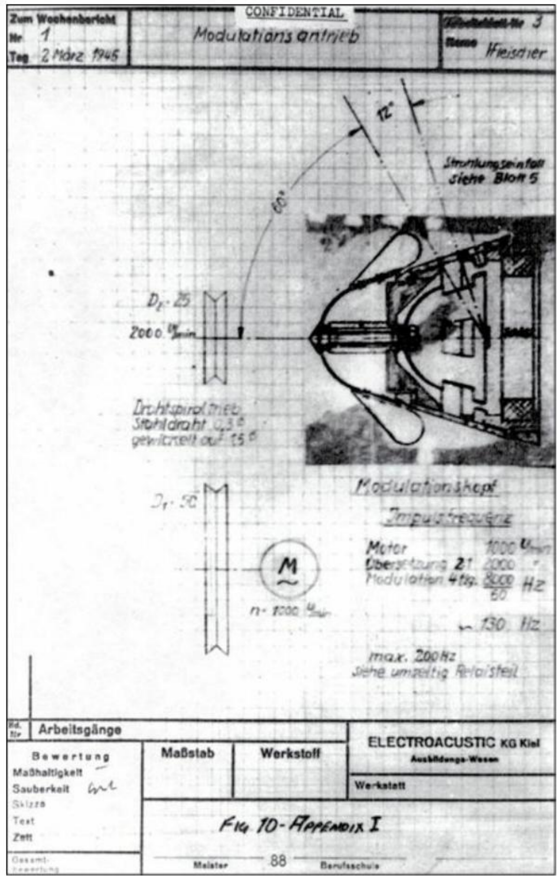


Diagram of the thermal management system intended for the *Wasserfall rocket .* (NARA)

Although these solutions never reached the stage of series production, the Germans attached great hopes to them. They took first place in the whole group of signage systems. This should come as no surprise when we consider the importance of these devices today. However, it may come as a surprise that the automatic acoustic guidance systems came second. Perhaps this was simply a result of their availability and controllability of their underlying technology, rather than their military superiority over other solutions.

No less than eight types of these devices have been developed.

The available sources contain very sparse descriptions; the solutions[112] also represented a typical technical dead end of military technology development (and soon fell into oblivion). However, it is worth familiarizing yourself with this information, even if it

are fragmentary. So here is a short list: 1. The

valerian system - developed as a result of a collaboration between the companies Telefunken and Messerschmitt (works in Hallein). This solution was relatively complex, involving a tube amplifier with 12-16 tubes and four sensitive microphones using mica crystals. Nevertheless, their range was at least limited - it was no more than 350 m. An exception was the Me-262 jet aircraft, in which a longer range could be determined. An advantage, as with the other solutions based on the same principle, was the large field of view of around 180°.

2. A similar system has been developed (about 60%) in the Elac factories. It didn't have a name yet. Its potential range has been estimated at up to two kilometers.
3. In the company Ruhrstahl AG under the direction of Dr. Kramer developed an acoustic system that would be used in the modernized version of the X-4 air-to-air missile. It was given the alias *Poodle.* The system was relatively simple, based on four resonant membranes and two to three electron tubes. Not a single copy was completed; the possible range was estimated at 500 - 1,000 m.

4. A similar system, but equipped with four microphones (the direction was determined by measuring the phase shift between them), was developed in the Post Laboratories under the direction of Dr. days developed. This solution was intended for the *Rheintochter* rocket. Their parameters are unknown.
5. We know even less about the work on four other devices of the type described - neither names nor aliases are known. All that is certain is that the development was carried out in the Post Laboratories (Dr. Schops, Würzburg), in a facility called AVP (Prof. Kussner, Göttingen) and in laboratories that were located in the Darmstadt area and dealt with measurement technology and in particular with vibration measurements. The latter type was developed by Prof. Lubke from Braunschweig.

Another small but interesting group presented concepts from

radar systems, two semi-active and one active (both transmitter and receiver should be on the floor). The first two wore the aliases *light* and *blue light,* the active solution was called *dachshund .* The Swiss Post research institutes had a monopoly in this area: the light system was developed by Dr. Pressler, the *blue light system* by Dr. Heymann and the *Dachshund* System by Dr. V. Octingen developed.

All were based on 9-12 electron tubes, whereby we find the astonishing information in the description of the Dachshund device that "in addition" two diodes were used - should these be other semiconductor elements?

All three solutions should have a target detection range of one to two kilometers, but no tests were carried out on the test site, although the work was already very advanced by the end of the war
were.

As an addition to the concepts mentioned above, an active solution based on the Doppler effect could be mentioned. Despite being given an alias *(Max),* development practically never got beyond the initial concept. *Max* was introduced by Dr. Gullner designed by the Blaupunkt company.

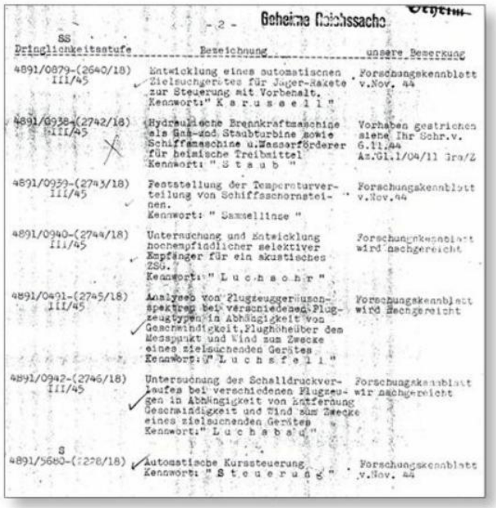

Fernsteuerungstechnische Forschung

Geheime Reichssache

Bearbeiter: Prof.Dr.Dr.e.h.F.Gladenbeck
Berlin NW 7, Dorotheenstr.35
Tel. 12 69 31

Betr.: Ihre Liste über Dringlichkeitsstufe " SS "
vom 1.7. - 30.9.44

SS Dringlichkeitsstufe	Bezeichnung	unsere Bemerkung
4891/0724-(2447/18)	Flugziele unter Ausnutzung der Propeller-Modulation Kennwort: " M o r i t z "	siehe: unser Forschungsblatt v. Nov. 44
4891/0725-(2446/18)	Entwicklung eines zielsuchenden Gerätes auf Flugziele unter Ausnützung des Doppler -Effektes . Kennwort: " M a x "	Forschungskennblatt v.Nov. 44
4891/0726-(2445/18)	Einbau eines Bildwandlers nebst UR-Scheinwerfer auf Versuchsboot Kennwort: " Seeschwalbe "	Vorhaben gelöscht siehe unser Schr. v.18.11.44
4891/0727-(2474/18)	Entwicklung und Fertigung von UR-Fotozellen für zielsuchende Nachsteuergeräte Kennwort: " U h r "	Forschungskennblatt v.Nov.44
4891/0728-(2451/18)	Entwicklung eines Zielsuchgerätes auf Strahler im dm-und cm-Bereich . Kennwort:" Grasmücke "	Vorhaben zurückgezogen siehe unser Schr.v.5.9.44
4891/0767-(2499/18)	Versuchsapparatur zum Zweck der Steuerung eines Bootes mit Hilfe einer zielsuchenden Einrichtung Kennwort:" L i n s e "	Forschungskennblatt v.Nov.1944
4891/0843-(2592/18)	Akust.Zielnetzgerät mit Hochleitungsmikrophon und Phasen-Relais unter möglichster Einsparung von Röhren . Kennwort: " L u c h s "	Forschungskennblatt wird nachgereicht
4891/0869-(2630/18) III/45	Entwicklung einer Stromquelle für ein elektrisches Zielsuchgerät Kennwort": Q u e l l e "	Forschungskennblatt v.Nov. 44
4891/0877-(2638/18) III/45	Vorrichtung zur fotoelektrischen Regelung von Amplitude und Schnittpunktanlage einer achtförmigen Abtastung der unmittelbaren Umgebung eines Lichtpunktes Kennwort:" Fühler - Regelung "	Forschungskennblatt wir nachgereicht
4891/0878-(2639/18) III/45	Vorrichtung zur 8-förmigen Abtastung d.unmittelbaren Umgebung eines Lichtpunktes, regelbar nach Amplitude u.Schnittpunktlage. Kennwort: " F ü h l e r "	Forschungskennblatt v.Nov.44



- 2 - Geheime Reichssache

SS Dringlichkeitsstufe	Bezeichnung	unsere Bemerkung
4891/0879-(2640/18) III/45	Entwicklung eines automatischen Zielsuchgerätes für Jäger-Rakete zur Steuerung mit Vorbehalt. Kennwort:" K a r u s s e l l "	Forschungskennblatt v.Nov. 44
4891/0938-(2742/18) III/45	Hydraulische Brennkraftmaschine als Gas-und Staubturbine sowie Schiffsmaschine u.Wasserförderer für heimische Treibmittel Kennwort: " S t a u b "	Vorhaben gestrichen siehe Ihr Schr.v. 6.11.44 Az.Gl.1/04/11 Gro/Z
4891/0939-(2743/18) III/45	Feststellung der Temperaturverteilung von Schiffsschornsteinen. Kennwort: " Sammellinse "	Forschungskennblatt v.Nov.44
4891/0940-(2744/18) III/45	Untersuchung und Entwicklung hochempfindlicher selektiver Empfänger für ein akustisches ZSG. Kennwort: " L u c h s o h r "	Forschungskennblatt wird nachgereicht
4891/0491-(2745/18) III/45	Analysen von Flugzeuggeräuschspektren bei verschiedenen Flugzeugtypen in Abhängigkeit von Geschwindigkeit, Flughöhe über dem Messpunkt und Wind zum Zwecke eines zielsuchenden Gerätes Kennwort: " L u c h s f e l l "	Forschungskennblatt wird nachgereicht
4891/0942-(2746/18) III/45	Untersuchung des Schalldruckverlaufes bei verschiedenen Flugzeugen in Abhängigkeit von Entfernung Geschwindigkeit und Wind zum Zwecke eines zielsuchenden Gerätes Kennwort:" L u c h s b a u "	Forschungskennblatt wir nachgereicht
S 4891/5680-(2278/18)	Automatische Kurssteuerung Kennwort: " S t e u e r u n g "	Forschungskennblatt v.Nov. 44

Documents of the Reich Research Council with aliases and brief descriptions of research projects related to the new remote control systems. (NARA)

The American Intelligence Service report [112] names two related systems that are based on the idea of passive radio location, ie, according to today's nomenclature, oncoming radio location (the system searches for enemy radar devices). These were the *Greyhound* and *Radish* devices , which were developed in Swiss Post's research facilities. Information on the former construction is very sparse; little more is known about the *radish system* that was able to be fully developed. Some finished copies were installed in the Fritz-X remote control bombs. The device weighed 15-17 kg and was based on the Strassburg receiver. It was distinguished by a very long range of up to 100 km (on a large target radiating about a kilowatt of power).

Complementing the above mosaic of diverse concepts is a single detector, helical scan optical system developed by a private research company led by a certain Dr. Rembauske was developed. It was aliased "Brush". Some prototypes underwent trials shortly before the end of the war. This made it possible to determine the actual range - it was up to 2,000 m. The field of view width was 40°.

Reichsforschungsrat
Der Bevollmächtigte
für fernsteuerungstechnische Forschung
Arbeitsbüro

Berlin NW 7, d.6. 10. 1944
Dorotheenstrasse 35
Fernsprecher 12 69 31

Tgb.-Nr. BFF V/3 1042/44 g

Reichsforschungsrat
12. OKT 1944
Akt. Nr. ...

An den
Leiter des Geschäftsführenden Beirates im Reichsforschungsrat

Berlin-Steglitz
Grunewaldstrasse 35

Geheim

Im Monat September wurden von hier aus folgende Forschungsvorhaben ausgegeben:

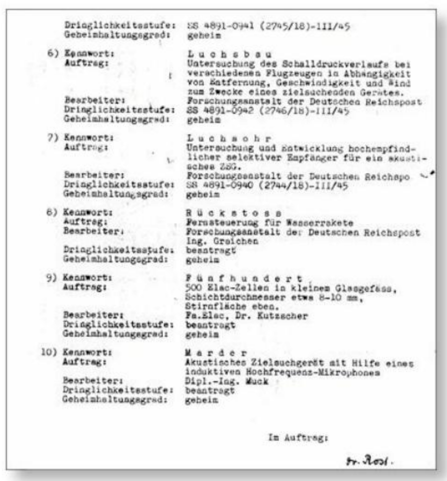
1) Kennwort: K a r u s s e l l
Auftrag: Entwicklung eines automatischen Zielsuchgerätes für Jäger-Raketen zur Steuerung mit Vorhalt
Bearbeiter: Elektromechanische Werke G.m.b.H. Karlshagen.
Dringlichkeitsstufe: SS 4891-0879 (2640/18)-III/45
Geheimhaltungsgrad: geheim

2) Kennwort: F ü h l e r
Auftrag: Vorrichtung zur 8-förmigen Abtastung der unmittelbaren Umgebung eines Lichtpunktes, regelbar nach Amplitude und Schnittpunktlage.
Bearbeiter: Institut für Uhrentechnik, Prof. Sewig
Dringlichkeitsstufe: SS 4891-0878 (2639/18)-III/45
Geheimhaltungsgrad: geheim

3) Kennwort: F ü h l e r - R e g e l u n g
Auftrag: Vorrichtung zur photoelektrischen Regelung von Amplitude und Schnittpunktlage einer 8-förmigen Abtastung der unmittelbaren Umgebung eines Lichtpunktes.
Bearbeiter: O.M. Hausser, Werk I, Neustadt/Coburg
Dringlichkeitsstufe: SS 4891-0877 (2638/18)-III/45
Geheimhaltungsgrad: geheim

4) Kennwort: S a m m e l l i n s e
Auftrag: Feststellung der Temperaturverteilung von Schiffsschornsteinen.
Bearbeiter: Wissenschaftlicher Führungsstab Prof. Küpfmüller
Dringlichkeitsstufe: SS 4891-0939 (2743/18)-III/45
Geheimhaltungsgrad: geheim

5) Kennwort: L u c h s f e l l
Auftrag: Analyse von Flugzeuggeräuschespektren bei verschiedenen Flugzeugtypen in Abhängigkeit von Geschwindigkeit, Flughöhe über dem Messpunkt und Wind zum Zwecke eines zielsuchenden Gerätes.
Bearbeiter: Forschungsanstalt der Deutschen Reichspost



Dringlichkeitsstufe: SS 4891-0941 (2745/18)-III/45
Geheimhaltungsgrad: geheim

6) Kennwort: L u c h s b a u
Auftrag: Untersuchung des Schalldruckverlaufs bei verschiedenen Flugzeugen in Abhängigkeit von Entfernung, Geschwindigkeit und Wind zum Zwecke eines zielsuchenden Gerätes.
Bearbeiter: Forschungsanstalt der Deutschen Reichspost
Dringlichkeitsstufe: SS 4891-0942 (2746/18)-III/45
Geheimhaltungsgrad: geheim

7) Kennwort: L u c h s o h r
Auftrag: Untersuchung und Entwicklung hochempfindlicher selektiver Empfänger für ein akustisches ZSG.
Bearbeiter: Forschungsanstalt der Deutschen Reichspo
Dringlichkeitsstufe: SS 4891-0940 (2744/18)-III/45
Geheimhaltungsgrad: geheim

8) Kennwort: R ü c k s t o s s
Auftrag: Fernsteuerung für Wasserrakete
Bearbeiter: Forschungsanstalt der Deutschen Reichspost Ing. Greichen
Dringlichkeitsstufe: beantragt
Geheimhaltungsgrad: geheim

9) Kennwort: F ü n f h u n d e r t
Auftrag: 500 Elac-Zellen in kleinem Glasgefäss, Schichtdurchmesser etwa 8-10 mm, Stirnfläche eben.
Bearbeiter: Fa. Elac, Dr. Kutzscher
Dringlichkeitsstufe: beantragt
Geheimhaltungsgrad: geheim

10) Kennwort: M a r d e r
Auftrag: Akustisches Zielsuchgerät mit Hilfe eines induktiven Hochfrequenz-Mikrophones
Bearbeiter: Dipl.-Ing. Muck
Dringlichkeitsstufe: beantragt
Geheimhaltungsgrad: geheim

Im Auftrag:
Dr. Rost.

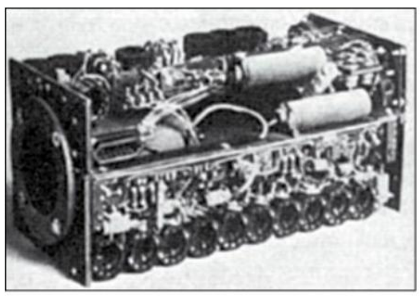
Documents of the Reich Research Council with aliases and brief descriptions of research projects related to the new remote control systems. (NARA)

A very important group represented the video systems, which are had a relatively high level of effectiveness.

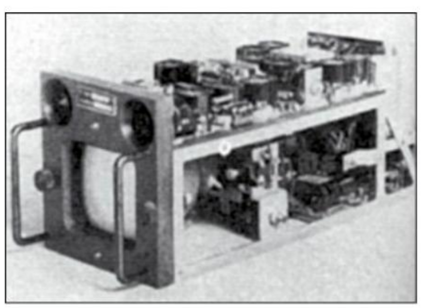
The addition of such a system (which was surprisingly mature) to the arsenal would, of course, not be possible without previous pre-war successes in this area. This enabled the fundamental technical problems to be overcome long before the outbreak of war.

Research into the use of television technology in the field of guided missiles, which was described in a very detailed report by the American intelligence service, had already begun in 1939. A number[113] of institutions and companies were involved, e.g. B. Blaupunkt, Siemens and the Fernseh GmbH - a company that was founded with the sole aim of conducting research in this field. The laboratories that served to realize this concept were located - at least at the end of the war - in the area of the research complex in Peenemünde.

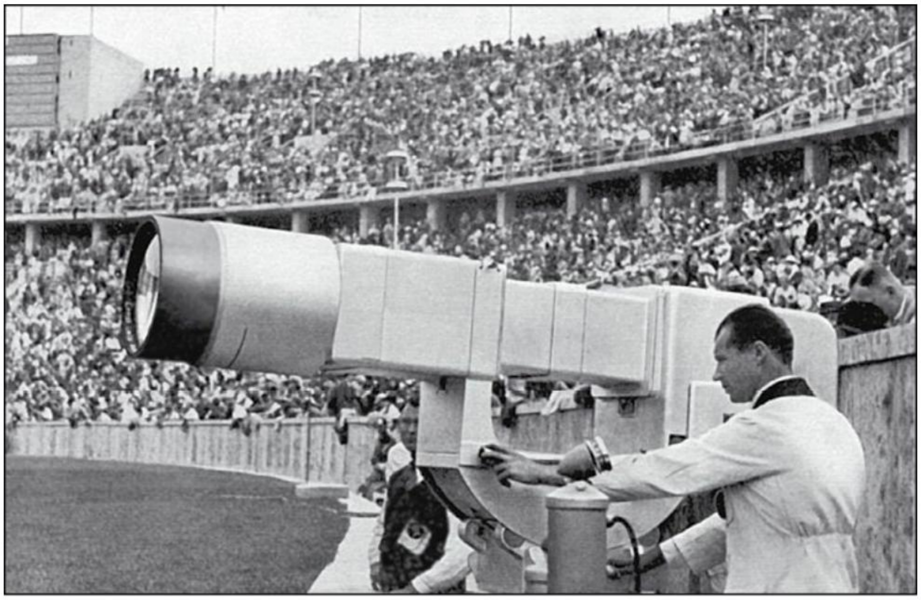
This was primarily due to the fact that the video system developed for the Hs-293 had also been modified for a second, unspecified type of rocket - so it was about yet another concept whose development only took place in September or October 1944 was initiated. The work on it has not been completed – a short description can be found later in this chapter.



The Tonne 2 Camera - one of the greatest electronic achievements of WWII. (Photo: NARA)



A modular television monitor placed on board the bomber. (Photo: NARA)



A comparison of the dimensions of the camera developed for the Hs-293 and a television camera from the mid-1930s shows how rapid technical progress was during the war. (Photo: NARA)

As for the variant intended for the Hs-293, its basic parameters are known. They primarily concern the video system itself, since the personnel of the mentioned companies knew very little about the method of image and command transmission between the missile carrier and the missile itself - this information was subject to the strictest secrecy. During the tests carried out by an air force unit, only one representative from Fernseh GmbH was present; only one person knew the technical details and the control system, namely Prof. Wagner from Henschel-Werke. Counterintelligence in this area was particularly pronounced.

In practice, however, projectile control was relatively simple. The technician who was on board the bomber had, among other things, a "joystick" (control lever) and a small modular television monitor, the dimensions of which were 8.8 x 8.8 cm. The above-mentioned report describes one of the system variants (code name *Tonne),* which was characterized by an almost unimaginable resolution of 441 lines at the time, which is practically comparable to modern Hi8 or SVHS systems and almost the home video system VHS with its 250 lines exceeds a factor of 2. This information refers to the *ton-2-*

Version.

The complete system, including the devices installed on the floor (but without the transmitter, antenna and battery), weighed around 50 kg. However, this weight could be reduced in the later modifications. This applied, among other things, to the *Tonne-4a model,* which was developed around the turn of the year 1944/45, or the Dr. Rombusch of the Physics Institute in Dressenfeld, where the camera (which was part of the system) weighed only 2.5 kg!

In the case of the Tonne 2 variant (and probably also in the later developments), the refresh rate of 25 Hz was high enough to ensure a smooth image even with a moving target. The field of view width was 40°.

The other system component, namely the radio link that enabled the transmission of images and control commands, was just as modern as the video part. The main problem that had to be overcome in their development was the noise immunity of the connection. Therefore, a whole series of solutions was developed, which were otherwise very similar to modern approaches and were based on rapid automatic frequency changes. It was initially planned to ensure synchronization between the transmitter and receiver by means of an additional radio signal that encoded both the transmitter and the receiver. However, this signal was also susceptible to interference.

Therefore, an “externally” coded system emerged. The task of synchronization was performed by precise quartz resonators (i.e. quartz clocks), which were adjusted before ignition. This solution worked extremely well in practice, but it was expensive. Another method was therefore tried - this time the television signal itself was used as a code source, ie as a source of information about frequency changes.
Theoretically, there was now a risk that if the connection was lost, it could not be restored; practical tests, however, could not confirm these fears. This solution worked just as well as the previous one and was adopted as the standard.

Available information indicates that a total of about 60 Hs-293 missiles equipped with the video system were launched.

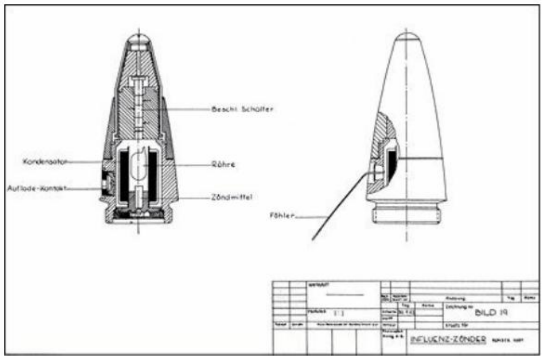
As a result, work on the development version of a

video guidance system intended for surface-to-air missiles.
However, this work could not be completed. Of course, the biggest changes were made to the guidance system itself – it was supposed to be “not much bigger than a proximity fuse” (length: 60 cm, diameter: 14 cm, without power supply and antenna).

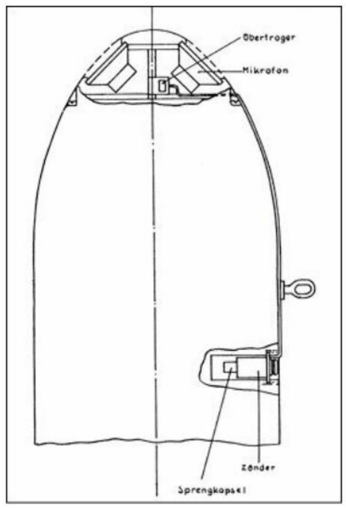
The development of this system (code name *Sprotte)* was mainly based on the miniaturization of previous components. The miniaturization of the camera meant that the resolution was reduced to 220 lines, and the battery was replaced by a small generator powered by a propeller protruding from the rocket body. This allowed the weight to be reduced to 10 kg compared to the 50 kg of the standard version of the Hs-293. It is not entirely clear what type of missile the Sprotte system was intended for; until the work was suspended it was probably not possible to commit to it, although certain preparations were made to implement this solution for the V1.

* * *

A fringe phenomenon of this complex of topics were the so-called proximity fuses, which caused the detonation of the warhead not by direct impact, but at the moment of its approach to the target, when the warhead reached a certain distance from it.
These fuses were particularly important in the case of anti-aircraft missiles, since their warheads were usually so explosive that they would have destroyed one or more targets even if detonated several meters away; on the other hand, it was much easier to hit a zone several meters in diameter than the plane itself. The proximity fuses were therefore a valuable, if not indispensable, addition to the guidance systems.



Schematic of an electrostatic proximity fuse *(induction fuse)* in a projectile. (Photo: CIOS)



Schematic of an acoustic proximity fuse in an aircraft bomb. (Photo: CIOS)

In order not to bore the reader with less interesting technical details, I will only present a selected type of such igniter in the following, which in my opinion represented the most successful design. It was an electrostatic detonator from the Rheinmetall company, which is an example of the rare combination of a simple design (and correspondingly simplified production) with high effect.

Above all, the fuze was able to withstand high acceleration loads and could be used for artillery shells used in anti-aircraft defense. Apart from that, it was also more reliable: initially its effectiveness was around 70-80%, then it eventually increased to 95% with projectiles hit by anti-aircraft guns

were fired (calibre: 88 mm). Aerial bombs weighing 50 kg and more were also tested during the tests.
The same was true of shells fired from an experimental Rheinmetall 75mm cannon (which was probably intended for the E 50 tank).

The fuse was shielded from the rest of the projectile and consisted of two electrically isolated parts between which a precisely defined electrical potential existed. In air, this potential was not significantly disturbed unless the detonator came close to an aircraft presenting a large conductive object.
Then the potential difference decreased, which led to the ignition of the detonator by means of a simple electronic circuit.

Test shots were fired mainly at steel nets stretched over special insulators, with the shells usually detonating at a distance of one to two meters in front of them. Later, this distance was increased to three to four meters - it was enough simply to readjust the gears. It was estimated that after making certain modifications, the detection radius could be increased to around 10-15m. The device was simply called an induction *fuse* and was probably the best design of its kind at the time of World War II (proximity fuses were also developed by the Americans). In total, the Germans made about 1,000 pieces, which were fired exclusively on the test site. Work on the igniter began as early as 1935. It was suspended in 1940, resumed in early 1944, only to be suspended again a year later (the proving ground trials took place during the latter period). The fuze was practically ready for production at this point (which could have been done much earlier), but similar to the case of night vision devices, it did not arouse the interest of the Wehrmacht bureaucratic elite.

The *waterfall* in the W-10 version.

fighter planes with ramjet propulsion

One of the most important, but at the same time least known (!) technical breakthroughs in the Third Reich was the ramjet and the attempts to use it militarily. Compared to the jet engine, it offered a similar qualitative quantum leap as the jet engines compared to the piston engines. And this breakthrough didn't just happen on paper!

Based on the generally available publications, this complex of topics can only be described inadequately. For this purpose, I have mainly used four technical analyses, which are mentioned in the bibliography. 102,109,118-9 But let's start with what a ramjet actually is.

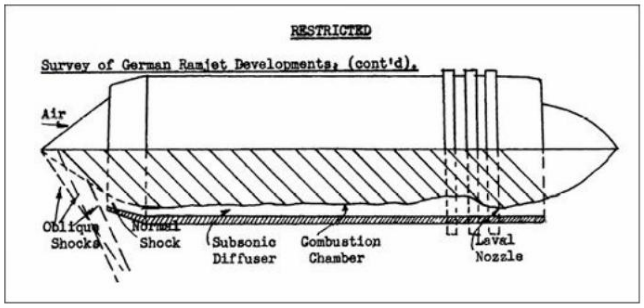
Such an engine represents, in a sense, an evolutionary development of the pulsejet engine used in the V1 rocket. Both designs are characterized by their simplicity, because they have neither a turbine nor a compressor. The pulse jet engine consists almost exclusively of a long tube that combines the function of the combustion chamber and nozzle, whereby it does not work continuously, but cyclically. In the front part of the tube there is a grid reminiscent of a grill, on which flaps are attached that act as valves. When the fuel-air mixture ignites in the front part of the pipe, the flaps close the inlet due to the increased pressure, which causes the combustion products to intensively expand backwards. This creates a recoil. Due to the fact that the tube is relatively long (it is about 10 times longer than its diameter), the inertial force of the combustion gases causes them to shift backwards longer than the high pressure is maintained in the part functioning as the combustion chamber. They therefore lead to the opening of the valve flaps, whereby the next portion of air is sucked in and the cycle starts again from the beginning. The pulse jet engine can work even when the carrier's flight speed is zero, on the other hand, the

Tests conducted during the war have shown that it quickly loses effectiveness as it approaches the speed of sound.
Therefore, this engine is not suitable to power future generations of combat aircraft.

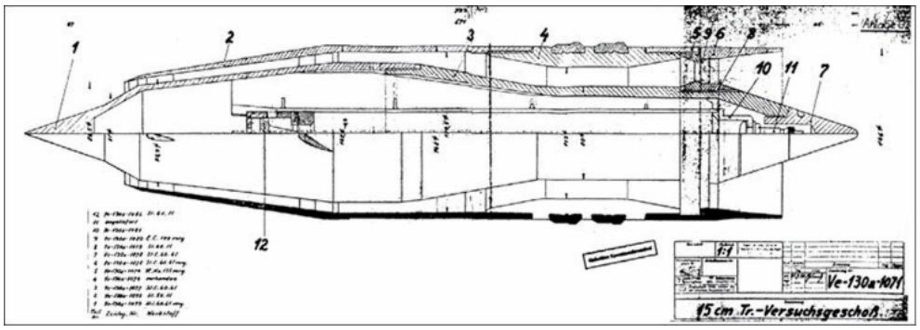
For this reason, the Germans began to look for solutions to overcome this disadvantage, remembering an idea that still dated from the pre-war period: the ramjet engine (known at the time as the "Lorin-Rohr" and in English-language nomenclature as 'athodyd'; currently the term 'ramjet' is common). At the time, it was just an interesting curiosity that didn't arouse much interest and was considered unpromising because (paradoxically) it wasn't suitable for powering the airplanes of the time - they were too slow for it. The ramjet engine can only work effectively at almost the speed of sound.

This results from the type of air compression. There is no “normal” compressor in such an engine. The shape of the housing is reminiscent of a tube in which there is a diffuser core with a relatively large diameter. The space between the “tube” and the “core” acts as the compression space and combustion chamber, with the thrust nozzle at the rear.

In most types, the front conical part of the "core" provides compression - but not due to "classic" aerodynamic principles. When the air flowing around the cone reaches the speed of sound, it creates shock waves that are superimposed near the annular air intake. The shock waves cause the gas to be compressed to a density comparable to the density of liquids. This is precisely the key to the operating principle of the ramjet engine, which eliminates not only the compressor but also the turbine (behind the combustion chamber) that drives it.

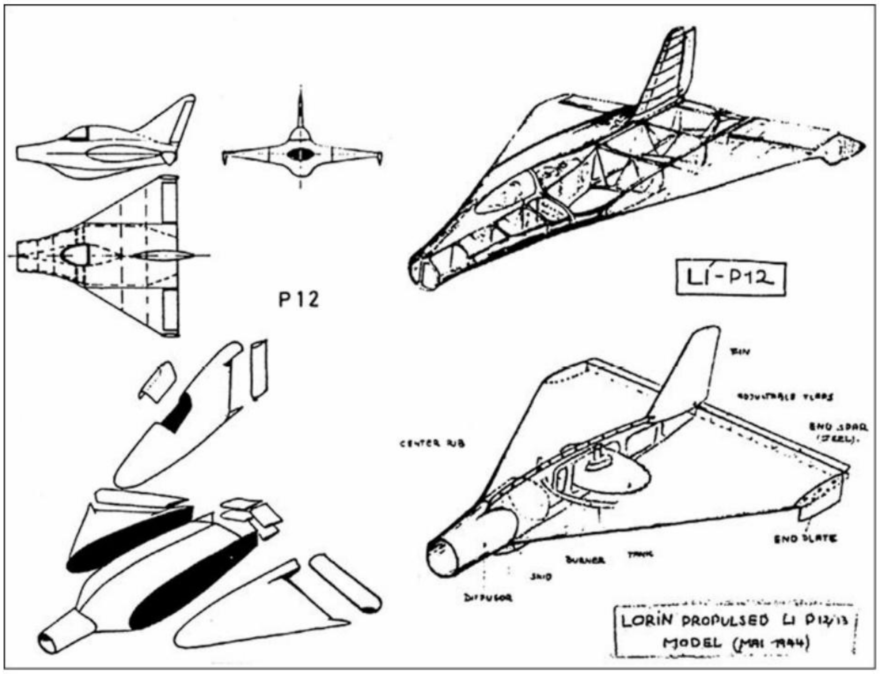


A ramjet engine that was characterized by a high level of development and was probably designed by Oswatitsch. Half cut from a report by the American intelligence service.



Original scheme of the 150mm "Trommsdorff bullet". This projectile reached a maximum speed of 5255 km/h. Atypical carbon disulphide was used as fuel. (photo from the author's collection)

In this way, a jet engine could be designed with almost no moving parts. The Germans had the courage to risk everything on this one card ... and, thanks to the commitment of many outstanding scientists, overcame the fundamental technological hurdles within just a few years. Many of these achievements remain practically unknown, although the author of the largest Polish professional study gave them a high rating and drew attention to the following aspects: 102



One of the first concepts of Lippisch's ramjet-powered flying wing, designated P-12. Work on this solution was interrupted in May 1944; at the same time, the Germans began to develop the target version P-13b, which was completed on 01/07/45.

“Sänger conducted experiments using special blocks pressed from fine coal and plastic, which were used to line the inner walls of the combustion chamber to protect it from damage. Pabst, an employee of the Focke-Wulf company, rebuilt the tube of the engine in order to shorten it [to about twice the tube diameter – ed. Autors], and Tromsdorff invented fragmentation projectiles powered by Athodyd engines, which were characterized by high flight speeds and enabled long-distance bombing. The theoretically calculated firing range was 450 km.”

In connection with the development of the ramjet engine, the most prominent researchers from the aviation and rocket industry were engaged, including: • Test engineer Eugen Sänger, father of German rocket research;
• H. Walter, who did research in the laboratories in Kiel; • Prof. the

Alexander lipstick, one outstanding

Aviation designers of the Third Reich. He designed the flying wing; • dr Klaus Oswatitsch, employee of the so-called Prandtl Institute in Goettingen.

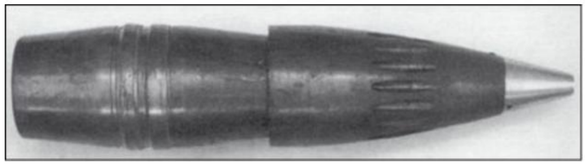
• Ing. Pabst from the Focke-Wulf companies.

Most significant was undoubtedly the contribution of Eugen Sänger, a pioneer in the field of ramjet research, who laid the foundation for later successes in this field. As early as 1938, his detailed report on the development prospects for these engines was published, which included an in-depth theoretical analysis. Future researchers treated this report almost as a handbook, allowing them to further develop the ideas it contained.

Singer saw the ramjet primarily as an alternative to rocket propulsion (and not jet propulsion, as in the case of the other designers), or as a complement to it. He was particularly interested in the rate of climb that a fighter plane taking off could achieve with it. Economical fuel consumption was therefore of secondary importance, since the engine was only supposed to work during a short, precisely defined flight phase. The key parameter, paid attention, the combustion
on the Singer after conducting tests was it
temperature. He aimed for the highest possible fire point of around 2,000 °C, but turned out that in practice the temperature usually did not exceed 600 °C.

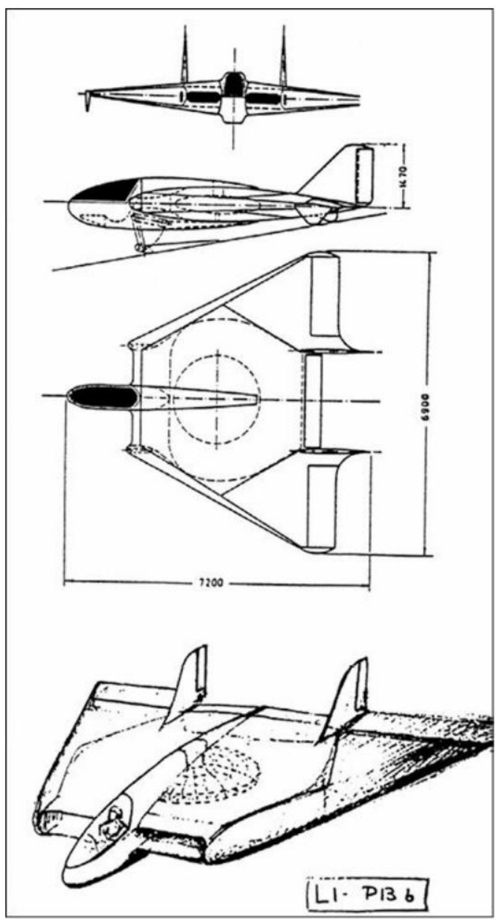
His concepts featured an exceptional length-to-diameter ratio, typically 10:1, although one of the prototypes was a whopping four meters long. From the very beginning, Sänger assumed that the entire increase in pressure of the gases would have to take place in the combustion chamber (as it turned out in the early 1940s thanks to the work of Pabst and others, this limitation could also be overcome in other ways).

Singer built many prototypes that were attached to vehicles and tested at high speeds. A bomber was also used for this purpose, at least in one test series. However, a ramjet engine built according to his concept was never tested in a wind tunnel. Nevertheless, "initial data" could be collected that described the basic dependencies of the new drive.



The Trommsdorff bullet with a caliber of 105 mm. (photo from the author's collection)

The basic quality of his concepts was simplicity. The engine consisted of a long pipe with a cone-shaped diffuser attached at the front, which optimized the intake of air. In the front part of the pipe there was a lattice made of steel pipes. They were fitted with several dozen orifices that acted as fuel nozzles and were directed forward to ensure the best possible mixing of the fuel with air through turbulence.



The P-13b was a special fighter in many ways. Noteworthy are the large air intakes on the sides of the cockpit, the exhaust outlet on the

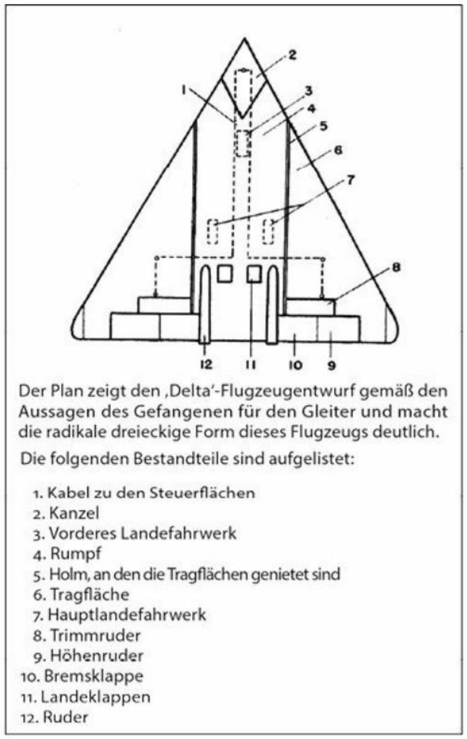
Trailing edge of the wing and the disc-shaped, horizontally arranged combustion chamber.

In 1941-42, the above-mentioned tests were conducted in the air using the Do-217 bomber. The subject of the tests was a large engine, about 3 meters long. The engine was not equipped with gauges, but the pilot noticed that after switching it on, the flight speed increased only by several tens of kilometers per hour (at an average speed of about 400 km/h). Taking into account fuel consumption and the size of the ramjet itself, the results were unpromising.

Singer later tried to introduce certain improvements, but could not achieve a breakthrough. He probably lost faith in the success of his concepts himself, since from then on he only paid marginal attention to this work - he began, among other things, to develop a rocket engine with a thrust of 100 tons. Therefore, the planned tests on a Me-262 fighter were no longer carried out, and the aviation plants of Skoda and Heinkel, which had shown "pre-interest" in Singer's concepts before the completion of tests on the Do-217 bomber, soon lost it again . 109,118

Despite the "initial head start", Sänger was overtaken by its competitors during the war. Professor Lippisch was one of the most respected among them. Although not much is known about its unusual engine design, American documents contain clear information that flight tests were being conducted - so the research must have progressed.

(scientists and engineers) described this as follows: [102]



Another version of the P-13b described in a US intelligence summary dated April 8, 1945. (NARA)

"Prof. Lippisch designed a ramjet aircraft with a special shape that looked confusingly like a bird's wing.
However, due to practical problems, the prototype was subject to continuous changes. This flying wing achieved a ground speed of 2,500 km/h and the pilot took a banked position to make use of the dive option. The wings were tilted backwards by the designer; the air entered through an opening in the nose of the aircraft. Solid propellant rockets were used in order for the aircraft to reach sufficient speed, which was necessary for the operation of the ramjet engine. The air was conveyed by a [around the vertical axis – d. author's] rotating compressor, which developed a high enough speed to achieve sufficient compression at high altitudes. The compressor was not a turbine, because in the case of Lippisch's machine, white-hot blocks of hard coal were placed in the combustion chamber immediately before take-off to increase the temperature and

to generate an initial boost. Other systems were fitted with liquid hydrocarbon injectors to allow the air temperature to be increased. Sufficient initial speed was achieved before launch through the use of ATO booster rockets, and the incoming air ignited the bituminous coal even more, increasing the thrust even further. The heated gases flowed out through a narrow opening at the trailing edge of the wing. This method made it possible to maintain usefulness for 45 minutes. In the last months of the war, the heat capacity of the material was increased by a factor of 2 by injecting liquid fuel over the coal."

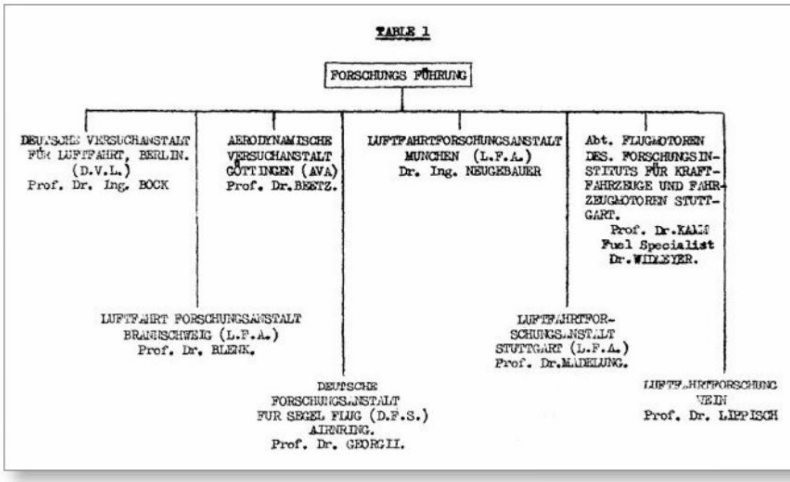
Professor Lippisch's ramjet (P-13b) was also described in detail in an American intelligence analysis. 119 The technical drawings contained there show only a slight difference to the "trapezoidal variant" of the P-13b, which is also shown in this book. The air leading edges are not placed vertically in relation to the aircraft axis, representing a continuation of the leading edge sweep. Therefore, the aircraft has the shape of an almost perfect isosceles triangle. Since the report mentions draft work for at least two versions that were similar to each other, they may both have actually existed.

The report states that the ramjet was developed in different departments of the research institute LFW (Luftfahrtforschung Wien).
The division of labor was as follows:

1st wind tunnel: Tülln near Vienna.

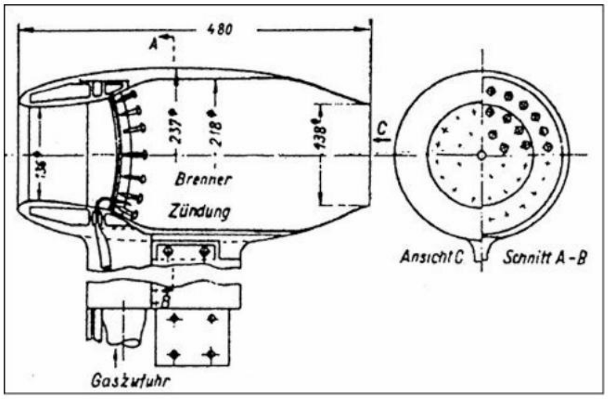
2. Most of the elements were manufactured in the LFW works in Wiesenfeld near St. Veit made.

3. The final assembly took place in one belonging to the LFW Institute Aircraft hangar in Ramsau an der Donau.

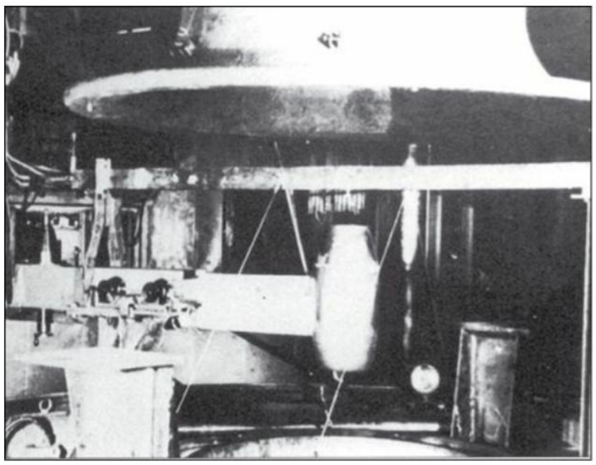


Organizational scheme of the research sector of the DVL (German Research Institute for Aviation), which also takes into account the Lippisch organizational unit. (BIOS)

Lippisch's office was in Tülln, where he worked from early 1943 until the end of the war. The P-13b was built mostly of wood. Most of the elements were made of 18mm thick plywood laminated with a special plastic called 'Dynal'. This laminate was probably also used for the outer skin, which, by the way, would have to be quite thick if it was to survive supersonic flight. The number of metal elements in the airframe was reduced to a minimum and was mainly limited to two parallel stringers that reached from the outer edges of the air intakes to the fins. Of course, metal was also used for the engine, the cockpit fairing, the steering cables and the tripod landing gear, which retracted hydraulically (although how the problem with the hydraulic drive was solved would be an interesting question).



Original construction drawing of a *driving wing motor.*



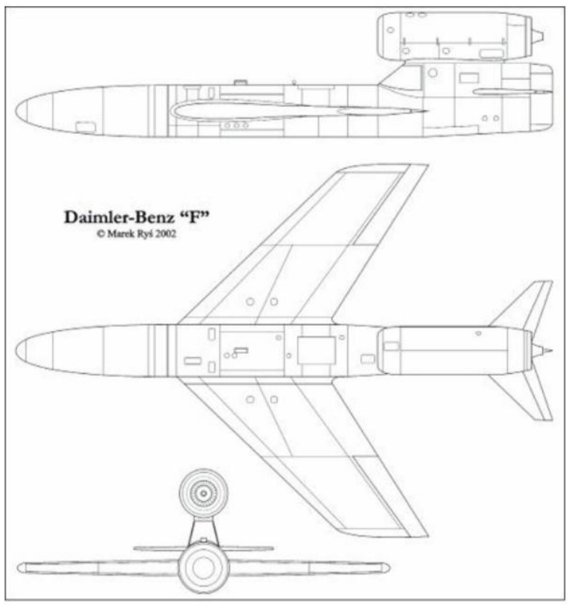
One of the "arms" of the *engine wing* in the wind tunnel. (Photo: LFA)

Of course, the most interesting and curious thing was the engine itself. The Americans provided some information about its fuel. These were special, standardized hard coal briquettes that were manufactured by the Siemens company in Berlin. They weighed 250 to 280 grams and had a calorific value of 8,000 cal/g. They were desulfurized and left unusually little ash. Before the flight, this “fuel” was heated up in a special oven. After reaching the target temperature of 950 °C, the "refueling" took place - the briquettes were placed in the combustion chamber (800 kg were intended).

In the first days of 1945, when the prototype P-13b was being prepared for the first flight, the American source of information “dried up”. Since it was expected to reach the magic speed of 2,440 km/h, according to American figures, it wasn't lacking

Test pilots ready to embark on this unusual adventure.

Fortunately, the gap in the mentioned report is filled by the well-established Polish treatise of 1951 (notably the best work on German rocket weapons that I have ever come across - at the same time it is the official publication of an institution whose tasks included research into German technology, and comprises almost 1,000 pages). There is the following description (in which information quoted earlier is partially repeated): [102]



The "F" from Daimler-Benz was the perfect candidate to be equipped with a ramjet. (Drawing: M. Ryÿ)

"The launch of the 'flying wing' was carried out using launch rockets from an inclined ramp. At a relatively high speed, the air entered the inlet of the propulsion tube (ramjet/pressure jet engine), was compressed and entered the combustion chamber, in which the glowing blocks of hard coal were located. The glowing coal increased the gas temperature and pressure. […] The device was very simple, requiring neither flaps that could fail constantly, nor any other mechanical means. The thrust depended only on the temperature inside the combustion chamber and the flight speed. The exhaust jets from the drive pipes kicked

out of the trailing edge of the wing. This model of the rocket fighter was manufactured towards the end of the war and underwent extensive testing in the months leading up to the surrender. In the original variant, only hard coal was used to generate the thrust, which was available for 45 minutes. Later, however, liquid paraffin was used, which was sprayed onto the coal, which almost doubled the thrust duration. A disadvantage of this propulsion system is the engine thrust. The engineers tried to overcome this disadvantage by two approaches: a) regulating the cross-sectional area size of the jet nozzle; b) Equipping the propulsion tubes with a control that would allow the cross-sectional area of the nozzle throat to be varied, thereby affecting the thrust."

It doesn't take much of an imagination to imagine that the inclusion of the supersonic P-13b in production would have completely revolutionized air warfare. Within a few years, there was a huge leap from the 1920s to the 1970s - that is, by about half a century!

The further fate of the P-13b is described in the chapter on operations *Paperclip* and *Lusty* set out.

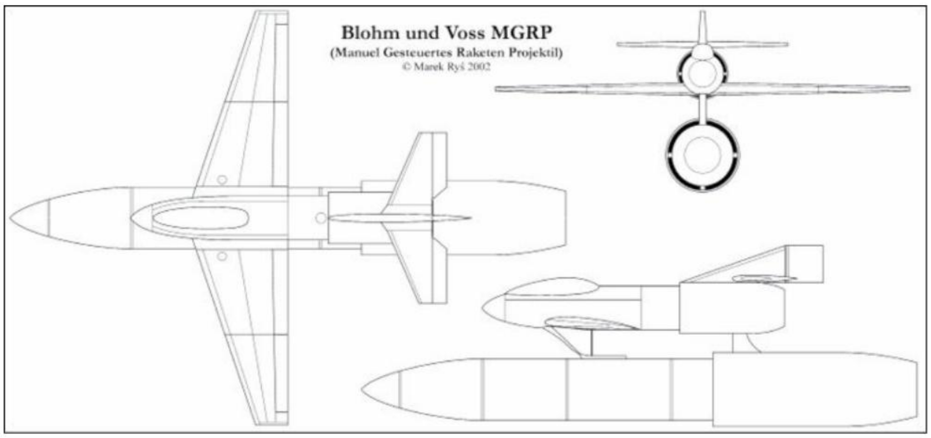
The P-13b was by no means the only fighter of this type. Two others ··· were designed in the Focke-Wulf works. From the

From a technical point of view, they were also unique in their kind.
Let's start with the VTOL (Vertical Take Off and Landing) fighter wing . The name reflects the unusual principle. During take-off and landing, the wings functioned as rotor blades, but during high-speed flight they turned into normal wings.

The aircraft had a spindle-shaped metal fuselage. At its center of mass, a purpose-built giant bearing was mounted in the fuselage axis, connecting the aircraft's fuselage to three rotating wings.
The wing tips were equipped with three ramjet engines with a maximum thrust of 840 kg each. During launch they were assisted by three of Walter's rocket engines. Your task was

to accelerate the wings to a speed that would allow the ramjets to engage. During take-off and landing, the fuselage should be in a vertical position - the cockpit was in the nose cone, and the pilot was turned 90° backwards at this point.

The aircraft had four large tail fins with small landing gear at the ends. The main landing gear, on the other hand, which consisted of a large single wheel and a huge telescopic shock absorber with a large stroke, was located in the axis of the fuselage. The takeoff of this plane looked like this:



The Blohm and Voss MGRP. (Drawing: M. Ryÿ)

First, the wings, together with the engines located at their ends, were positioned in the plane of rotation (the sweep angle was minimal). As the rocket engines spun the wings faster and faster, this angle was gradually increased, and at sufficiently high speed, the main engines were started. Takeoff and climb required a wing sweep angle of several tens of degrees. During the ascent, the hull inclination slowly increased.

At the same time, the sweep angle continued to increase while the wing speed decreased - but the speed of the aircraft increased more and more. After that, the flight was no different from the flight of a classic airplane - both the wings and the engines performed the same function as on any other airplane.

In contrast to many other unconventional solutions, the *powered wing* proved itself in practice - the flight tests carried out in the last months of the war turned out to be very positive.

The concept of the *powered wing* was perfectly adapted to the advantages and disadvantages of ramjet propulsion. As already mentioned, the main problem was to ensure effectiveness (thrust) at low flight speeds. The ingenious concept solved this problem completely, as the wing tips moved with sufficient speed even when the airspeed was zero. In one fell swoop, not only were the limitations of ramjets overcome, but the range of allowable flight parameters was also significantly expanded compared to the “ordinary” jet fighter.

The *powered wing* was even capable of hovering!

The aircraft was designed by a number of specialists led by Dr. Pabst, Halem and Multhopp (probably the best aerodynamicist of the time), the concept itself having been suggested by Professor von Holst, who was said to be inspired by the flight of insects. There is no question that an unconventional helicopter, conceived in Wiener-Neustadt in 1942, also contributed at least in part to this inspiration. It was designated WNF-342 and was designed by a certain Baron von Doblhoff. Its rotor was not powered by a normal engine but by small rocket engines mounted on the tips of the wings. Although this helicopter had a piston engine with an output of 60 hp, its main function was to power the fuel pumps for the rocket engines.

Von Doblhoff's inspiration could at least have been that he housed a ramjet engine together with a rocket engine in one housing.

The well-established analysis of 1951 contains information about the practical possibilities of the powered wing fighter aircraft:[102]

> "Shortly before the end of the war, the design office of the Focke Wulf company developed the concept of a helicopter with 'Athodyd drive'. The fuselage was streamlined and featured a forward cockpit. The tail was equipped with four tail fins. Three rotors emerged from the fuselage, each of which represented an independent propulsion unit. Before takeoff, the blades were positioned at an angle that did not yet allow the helicopter to

to take off. The engines reached full thrust within five seconds. Then the pilot slowly turned the blades and the helicopter took off in the direction of the resulting force.”

In the further part of the description cited above, other little-known details are given: “The maximum vertical speed was 124 km/h. After the helicopter reached a sufficient altitude, it went into level flight and was controlled by rudder and ailerons.

[…] In level flight, the helicopter reached a speed of 1,000 km/h. The rotor turned at 520 rpm, which translates into a rotor rotation speed of 1,500 km/h.
The initial rate of climb was 7.5 km/min. The maximum rotor service life was 42 minutes and the helicopter had a range of 640 km. At an altitude of eleven kilometers, the horizontal speed was 800 km/h. […]
A gentle rotation of the engines allowed the machine to descend.
The forehead drag was only 20% of what a normal fighter with the same fuselage size would achieve.”

Technical data of the ***driving wing***

Length (height) 9.15 m Diameter at rotating wings 10.8 m	
Takeoff weight 5,175 kg Fuel weight (total) 1,500 kg Top speed	
approx. 0.85 Mach Maximum rate of climb 7,500 m/min (125 m/s)	
Climb rate at 14,000 m altitude 120 m/min flight time (depending	
on altitude)	0.7 - 3.4 hours
armament	two 20 mm MG-151 cannons
	two 30mm MK-108 cannons

Another ramjet aircraft is mentioned in the text: 102 “The Heinkel P-1080 was a tailless swept-wing 'athodyd' machine; the engines were built into the wings, at the point where the wings were connected to the fuselage.” The final sentence is also noteworthy: 102

> “During the tests it turned out that the possibilities of using athodyd drives at sonic and supersonic speeds were very large. The test results in the range of one to three times the speed of sound were excellent.”

The unprecedented successes described above, such as B. the narrow reaching of the speed of sound (if not even exceeding it) or the test flights with the fast VTOL jet fighter, were the main merit of the forgotten Dr. Pabst from the Focke Wulf companies. His discoveries have also remained practically unknown, although they represented milestones in aviation development!

These achievements are all the more astonishing when we consider that Pabst (inspired by Sänger's experiments) only began developing ramjet engines and rocket ramjet engines in 1940, as one of the American reports attests.[118]

Also the in Goettingen working Dr. Karl Oswatitsch could boast some interesting results, although his engines had never been tested in flight. In 1943-45 he worked on the development of engines that could be used to power supersonic aircraft and guided missiles, and wanted to reach speeds of about Mach 3. He carried out many very complex analyzes that convinced him that the construction of an aircraft with an intercontinental range, flying at an altitude of 20-30 kilometers at a speed of 2,000-3,000 km/h was well within the scope of the technology of the time lay. The high level of these analyzes and Oswatitsch's outstanding expertise make him the most progressive researcher from the group described. He would certainly have had a great future if his research had not been interrupted by the end of the war.

118

The Ta-283 was another ramjet fighter designed by Tank. This now-forgotten project was one of the most promising concepts of the Third Reich. And it wasn't just a paper project! The detailed Polish analysis, which has already been cited several times, contains a description of the flight tests of a prototype Ta-283:[102]

“It was a fighter plane modeled on a normal fighter, but with two distinctive features: the first was the shape of the fuselage, which was unusually reinforced at the rear and merged into the fin with the rudder; the second distinctive feature was two 'Athodyd' type ramjets mounted on relatively long arms on either side of the fuselage. Such placement made it necessary to strengthen the hull.

The cockpit, the upper part of which was made of Plexiglas, was hidden in the fuselage and was characterized by good visibility. It was about mid-fuselage. The wings of the fighter had a sweep of 45°. The 'Athodyd' engines had a diameter of 1,320 mm. In order to accelerate the aircraft to a speed necessary for the operation of the 'Athodyd' engines, a Walter rocket engine was installed in the rear of the fighter, which was designed for dual fuel and had a thrust of 3,000 kg.

Atomized kerosene, which was injected into the combustion chamber, was used as the fuel for the 'Athodyd' engines. The air flow condensed at the intake opening, released oxygen during the combustion of kerosene in the combustion chamber, increased its pressure and temperature, and rushed out through the nozzles at great speed. The aircraft, powered by its two 'Athodyd' engines, was able to develop an average speed of 1,100 km/h at sea level and reach a flight altitude of 9.3 km at a rate of climb of 90 m/s. However, after the plane had reached an altitude of 11 kilometers, its top speed in level flight decreased to 960 km/h. Experimentation revealed that the aircraft's rocket engine should be used to reach the operating altitude, but was not necessary for landing.

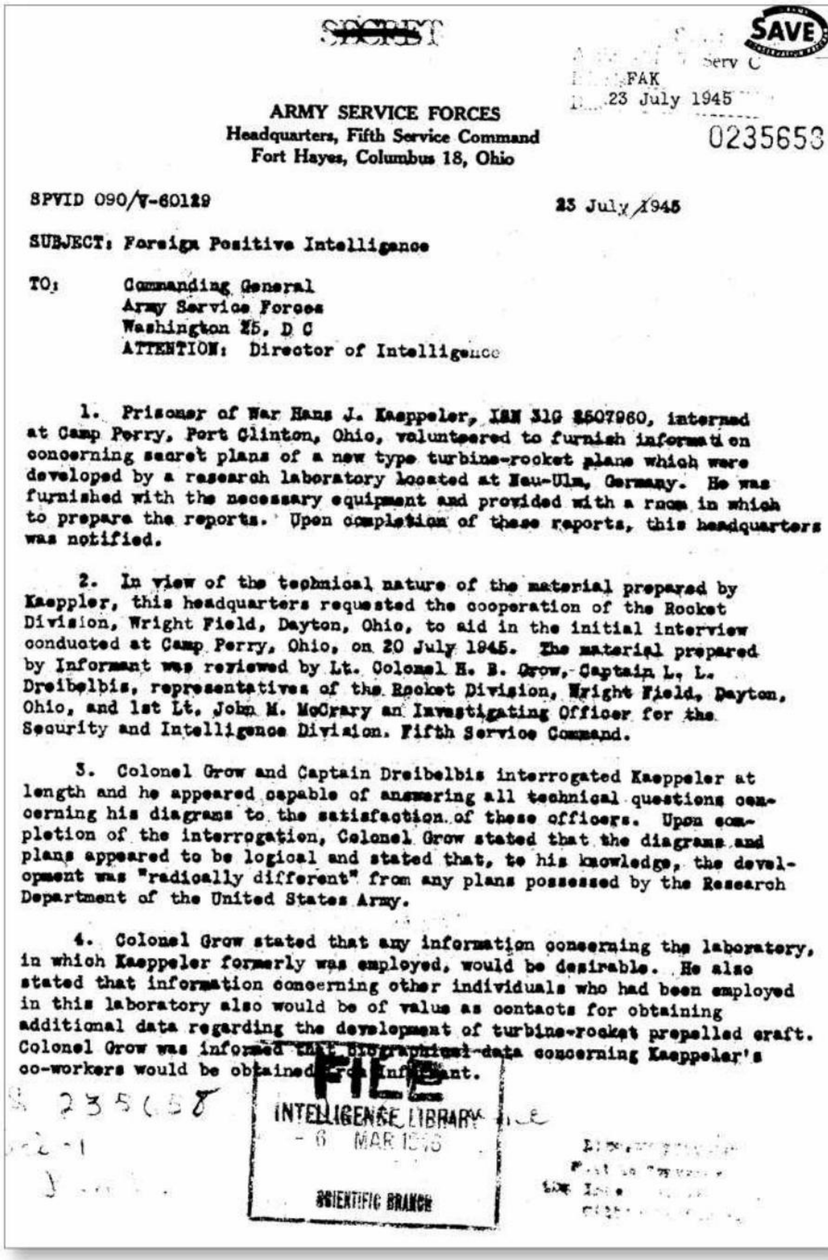
At sea level, the 'Athodyd' engines could operate for 13 minutes, but using rocket propulsion during launch and ascent to an altitude of seven miles was able to do so

a flight duration of 43 minutes can be achieved."

Technical details of the Ta-283

Aircraft weight: 2,700 kg Total weight	(aircraft
+ fuel): 5,450 kg Wing lift area:	
	$18.5m^2$

The advantages of ramjet propulsion, but above all its simplicity, made it possible to develop a number of aircraft/missile systems that would have represented an evolution of the Mistel system. An example of this tendency was the "Blohm and Voss MGRP", in which both stages were equipped with such a drive. At the time, this represented a possible avenue of strategic weapon development, when it was still difficult to reconcile long ranges with accuracy in the "complete" absence of the pilot.



SECRET

SAVE

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FAK
23 July 1945
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ARMY SERVICE FORCES
Headquarters, Fifth Service Command
Fort Hayes, Columbus 18, Ohio

SPVID 090/V-60129 23 July 1945

SUBJECT: Foreign Positive Intelligence

TO: Commanding General
Army Service Forces
Washington 25, D C
ATTENTION: Director of Intelligence

1. Prisoner of War Hans J. Kaeppeler, ISN 31G 8507960, interned at Camp Perry, Port Clinton, Ohio, volunteered to furnish information concerning secret plans of a new type turbine-rocket plane which were developed by a research laboratory located at Neu-Ulm, Germany. He was furnished with the necessary equipment and provided with a room in which to prepare the reports. Upon completion of these reports, this headquarters was notified.

2. In view of the technical nature of the material prepared by Kaeppler, this headquarters requested the cooperation of the Rocket Division, Wright Field, Dayton, Ohio, to aid in the initial interview conducted at Camp Perry, Ohio, on 20 July 1945. The material prepared by Informant was reviewed by Lt. Colonel H. B. Grow, Captain L. L. Dreibelbis, representatives of the Rocket Division, Wright Field, Dayton, Ohio, and 1st Lt. John M. McCrary an Investigating Officer for the Security and Intelligence Division. Fifth Service Command.

3. Colonel Grow and Captain Dreibelbis interrogated Kaeppeler at length and he appeared capable of answering all technical questions concerning his diagrams to the satisfaction of these officers. Upon completion of the interrogation, Colonel Grow stated that the diagrams and plans appeared to be logical and stated that, to his knowledge, the development was "radically different" from any plans possessed by the Research Department of the United States Army.

4. Colonel Grow stated that any information concerning the laboratory, in which Kaeppeler formerly was employed, would be desirable. He also stated that information concerning other individuals who had been employed in this laboratory also would be of value as contacts for obtaining additional data regarding the development of turbine-rocket propelled craft. Colonel Grow was informed that biographical data concerning Kaeppeler's co-workers would be obtained from Informant.

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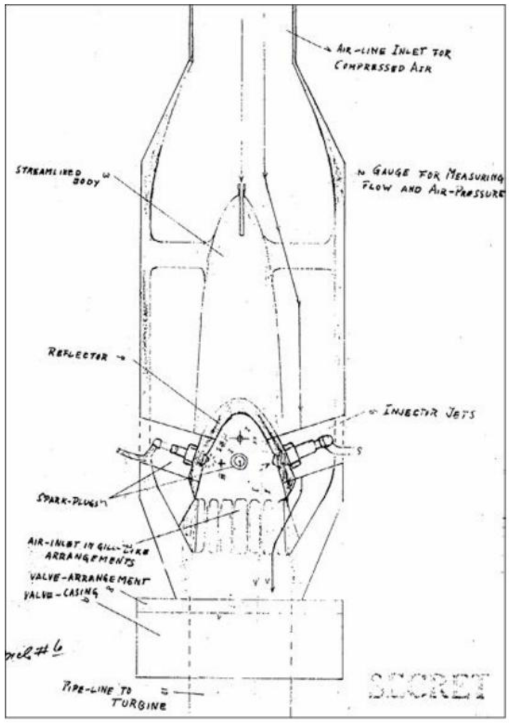
SCIENTIFIC BRANCH

A report by the American intelligence service about Hans Kaeppeler...

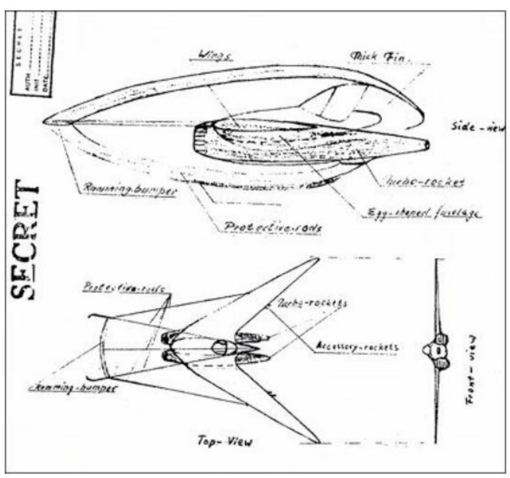
* * *

When looking through the archives of the American intelligence service, I also came across documents that show that the Germans had taken another route in their search for new aircraft engines ...120 It is about a collection of documents that contains a number of

advanced concepts that had been developed in an unnamed aviation design office in Neu-Ulm.



··· a construction scheme of the hybrid engine handed over by him ...



... as well as sketches of other designs he was working on. (NARA)

This material shows, among other things, that a kind of combination between a ram/pulse jet engine and a classic piston engine was developed, in which the turbine is behind the combustion chamber of the

ramjet unit was located. The description is incomplete, but the concept is noteworthy because the Americans classified Kaeppeler's documentation as "militarily important" and evacuated it to Japan at the end of the war; most of the German originals were destroyed. The report states, among other things, that this hybrid engine was powered by an unusual fuel. It was a milky-white liquid with a very pungent odor that evaporated very quickly, accompanied by a sharp drop in temperature. Their composition remained unknown.

biological weapons

At present, very little is known about German preparations for biological warfare, although there is no doubt that the development of this type of weapon of mass destruction is much less important than e.g. B. in chemical weapons.

Biological weapons were never prepared for combat use, although various plans were made by the end of the war. For example, the Germans probably planned to attack New York in this way - the missiles were to be fired from submarines (Operation *Elster).*

German scientific research institutions developed so-called "enzootic" disease-causing agents, and work on the use of anthrax bacteria, botulinum (a substance produced by bacteria of the genus Clostridium botulinum that develop in spoiled meat) and parrot disease viruses was well advanced . It is known that biological weapons were tested, among other things, on female prisoners of the Ravensbrück concentration camp.

Anthrax was possibly the most dangerous, mainly due to the very long lifespan of the pathogens, often several years, the almost 100% lethality and the rapid effect - death occurs within a few days after infection.

The anaerobic botulinum bacteria are somewhat less dangerous than the anthrax bacteria. When infected, they lead to death within one to ten days, but the mortality rate is lower at around 80%.
If the patient survives, however, it often takes no less than three to four months for full recovery.

The Germans were not far from the use of botulinum bacteria - aircraft sprayers were being prepared that would spray the bacteria in aerosol form. It would have become one of the greatest weapons of destruction of the Second World War - theoretically one gram of botulinum bacteria is enough to kill five to eight million people.

The German researchers suspected that the viruses of the so-called

parrot disease would be much more effective, although their "production" was much more difficult. They are characterized by lower lethality, but have a relatively long lifespan. One gram can (also theoretically) infect 20 million people. So, as you can see, biological weapons are in no way inferior to nuclear weapons.

The Third Reich also researched other types of biological weapons (such as pathogens and fungi that cause disease in plants and animals). However, the information about it is still very patchy. But the Germans were certainly not pioneers in this field; the Japanese were the first to use biological weapons in Mongolia in 1939. The British acted similarly a little later during the battles for the Malay Peninsula in Indochina.

Smaller and larger laboratories working on the development of biological weapons existed in all major warring countries: in the USA a corresponding center was established in Camp Detrick (Maryland) in 1942, in Great Britain a special "research station" was established in Porton in 1940, and in the Soviet Union such research was commissioned as early as 1938.

The Germans conducted such research in the strictest secrecy, which is why it is very difficult to find concrete information on this topic. In the early 1970s, the Main Commission for the Investigation of National Socialist Crimes took on this issue.
dr Rafaÿ Fuks, who worked with her, wrote a series of articles dealing with currently little-known aspects of German biological program employed. [121]

From this material it appears that already by the end of 1943, preparations for the production and mass use of biological weapons were in full swing. Various institutions were involved in the realization of this project, above all the Reich Research Council and the Institute for Military Research, which was subordinate to the pseudo-scientific "Research Association SS Organization German Ahnenerbe".

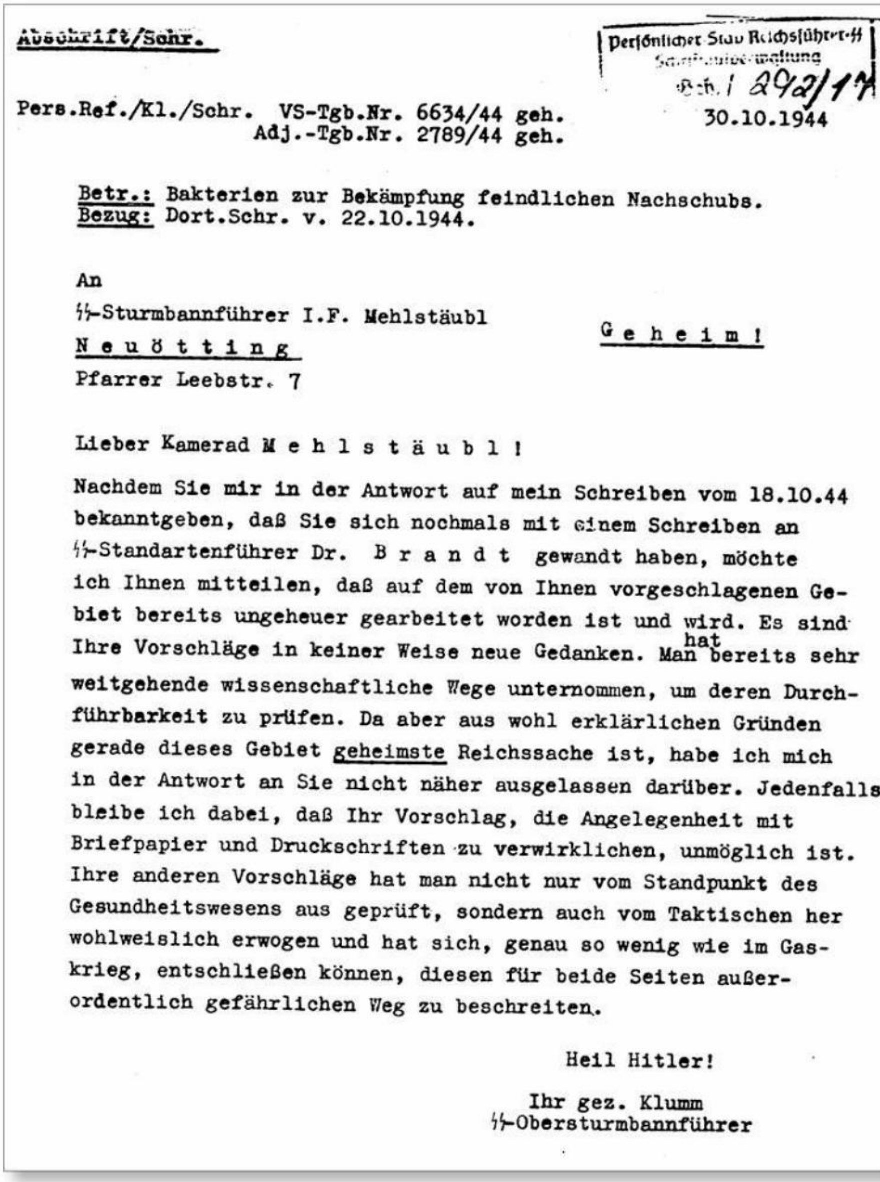
The program was initially to be supervised by Dr. Leonard Conti, who was State Councilor at the Reich Ministry of the Interior and head of the NSDAP's main office for public health. Eventually, however, Professor Kurt Blome, who was his deputy and at the time the

headed the National Socialist German Medical Association. Formally, he was authorized representative of the Reich Research Council for cancer research; in reality, this was just a convenient cloak. In May 1943, the true nature of Professor Blome's mission became clear anyway, when Goering officially appointed him "Biological Warfare Plenipotentiary".

The filling of this position did not result from the need to initiate appropriate preparations, as this had already been done, but from the coordination of various, mutually independent institutions. The following institutions were active in this area: the Department of Defense Science in the OKW (We-Wi), the Army Medical Inspectorate and the Army Veterinary Inspectorate.

Kurt Blome's circle was, of course, made up of proponents of the use of biological weapons. Although a certain lobby campaigned for this, such efforts initially played only a subordinate role in the Third Reich's armament efforts. It was not until September 1943, when the secret service report was presented, that the situation changed.

He described a meeting of American and Soviet biologists that is said to have taken place in Cairo in the same month. The report indicated that the Allies were preparing for a "biological offensive" against the Germans.



Abschrift/Schr.

Persönlicher Stab Reichsführer-SS
Schriftgutverwaltung
Az. / 292/17

Pers.Ref./Kl./Schr. VS-Tgb.Nr. 6634/44 geh.
Adj.-Tgb.Nr. 2789/44 geh.

30.10.1944

Betr.: Bakterien zur Bekämpfung feindlichen Nachschubs.
Bezug: Dort.Schr. v. 22.10.1944.

An
SS-Sturmbannführer I.F. Mehlstäubl
N e u ö t t i n g
Pfarrer Leebstr. 7

G e h e i m !

Lieber Kamerad M e h l s t ä u b l !

Nachdem Sie mir in der Antwort auf mein Schreiben vom 18.10.44 bekanntgeben, daß Sie sich nochmals mit einem Schreiben an SS-Standartenführer Dr. B r a n d t gewandt haben, möchte ich Ihnen mitteilen, daß auf dem von Ihnen vorgeschlagenen Gebiet bereits ungeheuer gearbeitet worden ist und wird. Es sind Ihre Vorschläge in keiner Weise neue Gedanken. Man hat bereits sehr weitgehende wissenschaftliche Wege unternommen, um deren Durchführbarkeit zu prüfen. Da aber aus wohl erklärlichen Gründen gerade dieses Gebiet geheimste Reichssache ist, habe ich mich in der Antwort an Sie nicht näher ausgelassen darüber. Jedenfalls bleibe ich dabei, daß Ihr Vorschlag, die Angelegenheit mit Briefpapier und Druckschriften zu verwirklichen, unmöglich ist. Ihre anderen Vorschläge hat man nicht nur vom Standpunkt des Gesundheitswesens aus geprüft, sondern auch vom Taktischen her wohlweislich erwogen und hat sich, genau so wenig wie im Gaskrieg, entschließen können, diesen für beide Seiten außerordentlich gefährlichen Weg zu beschreiten.

Heil Hitler!

Ihr gez. Klumm
SS-Obersturmbannführer

A document selected from the files of the personal staff of the Reichsfuhrer SS, which demonstrates the relevance of biological weapons research. (Photo: AAN)

Then noted Professor Kliewe, medical officer at the Army Medical Inspectorate and at the same time advisor to the Army Weapons Office, made the following remark during a meeting on September 25, 1943: “We shouldn’t just look on passively, we should make considerable efforts in the field of mass use of biological agents. First and foremost, America should be different

attacked by animal and human pathogens. The Fuhrer Adolf Hitler can be won over to this plan."

Under the terms of the agreement reached at this meeting, the bomber forces were to be the main means of transport, and in the case of the United States, the submarine fleet. These units should prepare their equipment for the new task accordingly.

In September 1943, the Wehrmacht took charge of the entire program. A special committee was set up in the Weapons Office's Wa-Prb-9 department to coordinate research on the most promising armaments programs, including biological weapons. It was given the alias *Lightning Rod Committee.*

Colonel Hirsch, a department head in the Weapons Office, took over his leadership. Committee members were Prof. Blome, Prof. Kliewe, Dr. Standien, Dr. Nagel from the Army Veterinary Inspectorate, Prof. Gerhard Rose, advisor to the Luftwaffe on tropical diseases, and a counterintelligence officer who was to ensure the secrecy of the research. Insufficient data on the distribution of pathogenic agents, their "contagiousness", etc. were identified as the main problem. The minutes of the first meeting of the *Lightning* Rod Committee include the following:

> "Since it has not yet been possible to determine whether and under what conditions the pathogens sprayed in aerosol form or in other forms cause diseases in humans, Prof. Blome suggested conducting tests on humans."

The Committee concluded that the lack of a specialized research facility, adequately equipped and adapted to, inter alia, conduct human testing was an obstacle to gaining experience in this area. However, this led to resistance from the Wehrmacht: Field Marshal Keitel is said to have said that the army should not be involved in such research. In the meantime, the last and still only meeting of the *Lightning Rod Committee* was already several months ago. In this situation, the SS took the initiative, which, incidentally, Blome had been striving for for some time. The Reichsfuhrer SS Heinrich Himmler was not only enthusiastic about biological weapons, but had also been carrying out corresponding experiments for a long time (among other things about typhus in the Buchenwald concentration camp) and was already able to carry out concrete ones

show results. Himmler called for the work to progress quickly. He therefore readily approved the construction project for a corresponding facility and, unlike Keitel, intended to start the tests as soon as possible. The Wehrmacht initiated appropriate measures to establish such an institution as early as 1943; However, these only really got going after the SS took over control. The facility was built on the site of a former educational institution of the Ursuline nuns' order in Pokrzywno (Nesselstadt) near Posen. The Germans used existing buildings and began to build new ones. The entire complex was surrounded by a two-meter high wall, with bunkers with loopholes at the corners. Greiser, the Gauleiter in the "Reichsgau Wartheland", showed a keen interest in this project, as did - in this case on Himmler's instructions - SS-Obergruppenfuhrer Wilhelm Koppe, Higher SS and Police Leader (HSSPF) in this area. In addition, Himmler sent Dr. Kurt Gross as his permanent deputy to Pokrzywno, who was later to monitor human experiments with the plague pathogen.

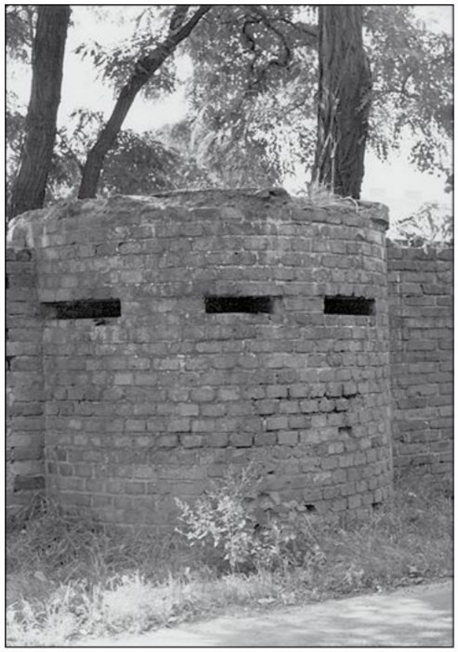
The Germans, of course, tried to maintain the strictest secrecy, but were not particularly consistent: the employment of over a hundred Polish workers, the SS guarding the facility, and the high wall attracted the enemy's attention. The Poles quickly recognized the real purpose of the building complex. One of the buildings was z. B. officially referred to as an animal testing station. It consisted of a changing room, from which a passage led to the bathrooms with baths and showers, and then to the toilets. Another passageway led to five toilets marked on the map as animal stalls. Access to this part was blocked by an armored door and a grate. One of the walls in the "stall" was made of thick armored glass, behind which there was a room for the staff. The tables in the dissection room also unequivocally indicated that the whole thing had nothing to do with animals, and other features also made it possible to guess the purpose of the complex: e.g. B. a building that was completely hermetically sealed off from the environment, disinfection chambers intended for a temperature of 80-120 °C, a poisoning chamber, a crematorium

...

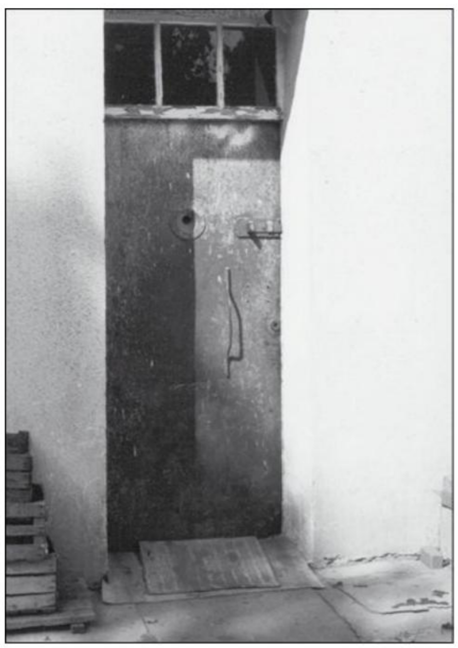
The whole complex was only completed in November 1944, when there was already a real danger that it would be taken by the Russians. Immediately after the work was completed, 115 Polish workers were taken inland to Thuringia, where they were to set up an identical facility. Despite Himmler's efforts and the support of the biological program by the Waffen-SS pseudo-scientific sanitation institute and the organization "Research Association German Ahnenerbe" (concentration camp), the research could only be initiated. They pathogens. After the Soviet January offensive in 1945, it was no possible to complete the program.

Walter Schreiber of the Academy for Military Medicine described it as follows: “In March[121] 1945, Prof. Blome, who had just come from Posen, visited me at the

Military Academy. He was very excited and asked me to accommodate his team and allow him to continue the experiments in the laboratories in Sachsenburg. Blome's worries were compounded by the fact that they had failed to blow up the institute. It was easy to tell from the equipment that was there that it was intended for conducting human experiments. They even considered the possibility of bombing the institute, but decided that was no longer possible. Prof. Blome asked me to make it possible for him to carry out experiments with plague cultures in Sachsenburg, which he was still able to save.”



Pokrzywno - a fragment of the wall surrounding the former laboratory.



Armored door leading into one of the buildings.

Chemical weapons

If one asks about the greatest danger that emanated from the National Socialist Third Reich for the world, the possibility of the production and use of nuclear weapons is emphasized above all.

This is a fundamental misconception.

The Germans were indeed only one step away from building an atomic bomb or nuclear warhead, but even if they had, their production capacity would have been very limited (the Americans, who had incomparably greater potential, managed it in the last months of the war to produce only three explosive charges: a trial charge and two bombs; the third bomb was not completed). In this way, as one of the captured German scientists put it, the Germans would have e.g. They could have destroyed London or New York, for example, but they would not have won the war by doing so.

However, there was another, much greater and quite real threat: chemical weapons. Their unimaginable effectiveness (also "modernity" in a sense) and large stores would have enabled Hitler to devastate all of Europe or kill tens of millions of people in the major metropolitan areas of North America alone, not to mention Poland (it was quite possible that the Germans wanted to stop the Soviet January offensive of 1945 in this way). However, we will come to the consequences of the potential combat use of chemical weapons later.

First, let's look at the situation just before the outbreak of war.

In the mid-1930s, the Germans mainly had toxins that dated back to the First World War or differed only slightly from them:

1. Eye and lung irritants (“white cross”). They were characterized by relatively low effectiveness and, as a rule, did not lead to death.
   Such substances were mainly intended for the police. Chief representative of this group was chloroacetophenone (which is still used today as a tear gas, although it is increasingly being replaced by the much more potent CS-

gas is replaced). Other substances marked with a white cross included organic bromine compounds (e.g.

B. bromoacetone) and bromine-containing acetic acid esters.

2. Irritants acting on the nasopharynx ("Blue Cross"). Similar to the substances from the "white" group, these were stable compounds in the form of powder or small crystals. They had a considerably more intense effect than the substances from the first group and were fatal in high concentrations. Among them were some organic arsenic compounds, with a warfare agent called “adamsite” playing the leading role (an interesting recent fact is that adamsite was used by the citizen militia against the protesting residents of Radom in 1976). This substance was not used during World War II. Its main advantage was that it could pass through the gas mask filters of the time.

3. Asphyxiating substances, referred to as "Grünkreuz" in Germany. It was mainly phosgene (Perstoff, Klop, Öl-F) and its derivatives, which belong to the chloropicrine group. These substances are already relatively dangerous - at an average concentration of 3 g/m^3 , death occurs in humans within one minute. During the Second World War, however, their potential importance was small.
4. Asphyxiating and corrosive substances ("Yellow Cross"), which were the most dangerous remnant of the First World War era. It was bis(2-chloroethyl) sulfide, the notorious "mustard gas" that was also known by the alias *Lost* . In this case, 2.6 g/m^3 was enough to kill a person within one minute.

Although the substances mentioned were later also manufactured on a large scale in Germany, they were primarily part of the chemical weapons arsenal of the Allied states. An exception was the Soviet Union, which was the weakest in this respect and had primarily hydrogen cyanide, which was relatively weak and difficult to use in practice (the chemical industry there was much less developed than in Germany).

At the beginning of the war, the arsenal of the "Yellow Cross" fabrics of the Third

Reich has been supplemented with the strongest and newest of the substances mentioned so far, namely tris(2-chloroethyl)amine with the designation T-9 *Nitromustard.* However, the advantage of higher effectiveness was opposed by the complex production process, which is why the actual importance of this substance was low.

This basically ends the arsenal of toxic "basic warfare agents" that were more or less available on both sides of the front and did not differ significantly in terms of their effectiveness from the poison gases known from the First World War. However, a coincidence led to the fact that shortly before the outbreak of war, the Germans made a radical breakthrough in this field.

This breakthrough went to Dr. Schrader, who developed new insecticides in a laboratory in Elberfeld. In 1937-38 he discovered a group of new phosphoric acid esters which were characterized by a very potent effect on the nervous system. Compared to previous "clumsy" toxins, their mode of action was unusually sophisticated, as they blocked so-called neurotransmitters (ie
Substances that are responsible for the transmission of stimuli between the nerve cells) and in this way certain stages of the cell metabolism are "cut through". The new substances, such as B.
Tabun (T-83, D-7, El-100 or Grünring-3), discovered in 1937, sarin (T-46 or T-144), discovered in 1938, and soman, which was synthesized somewhat later, beat the previous substances in each Considerably "by far" **because they could pass through gas mask and shelter filters unhindered, were** also well absorbed through the skin and, most importantly, were very toxic. They caused a very rapid death: tabun is deadly even at a concentration of 400 mg/m3, sarin requires around 100 mg/m3 and soman only 60 mg/m3 .

The most toxic of the substances previously available to the Allies - phosgene and a counterpart to the German T-9 - had to be used in concentrations of 3,500 and 2,600 mg/m3 , respectively, in order to be deadly.

So the Germans had every reason to take chemical weapons very seriously.

Various private companies took over production during the war. For the coordination was the committee for chemical

Warfare agents in Speer's Reich Ministry responsible for armaments and ammunition. The head of the committee was Dr. Otto Ambros, who was also the "liaison man" to the IG Farben concern, which acted as the main producer. A team of specialists and scientists based in different areas of the empire was responsible for coordinating each chemical industry. He included Dr. Pfaudler, Dr. Honey, Dr. Zwicknagen, Dr. fight and dr.
stone village. On the Wehrmacht side, Waffenprüfamt-9 was responsible for chemical weapons.

During the Second World War, over 200 million Reichsmarks were spent in Germany on the production of chemical weapons, this figure excluding fixed assets.

As early as 1937 the (albeit limited) production of some substances began, mainly mustard gas. It was not until mid-September 1938 that things really got going again, when the Army High Command approved the plan for rapid and intensive production of these special ordnance. It was estimated that over 27,000 tons of toxic warfare agents could be delivered in a short period of time, allowing chemical warfare to be waged for five months.

The Germans began to reorganize the chemical industry in order to adapt the previous, mainly pharmaceutical companies to the new requirements. In this way, among others, the C weapons factories in Ammendorf and Gendorf in Bavaria (both of which produced mustard gas, the former also T-9 *nitro mustard)* as well as the plants in Hahnenberg and Strassfurt, which were intended for the production of a new liquid adamsite derivative called *A-Oil ,* came into being were. The plants in Ludwigshafen, Seelze and Hahnenberg-Leese were converted for the production of chloroacetophenone.

All of these were in a sense ad hoc measures, since the realization of the ambitious armament plans required the construction of new facilities of the highest technical level. Only they could have carried out the difficult and dangerous production of the latest trilones (organophosphates). For understandable reasons, they also had to be protected against air raids.

In September 1939, the decision was made in secret to build large new (partially underground) facilities, research laboratories and a

Build a central storage facility for chemical weapons.

The choice fell on Dyhernfurth, today's Brzeg Dolny, about 40 km north of Breslau. The complex there was probably gradually annexed to the complex in Lubiÿÿ (Leubus) and was the most important armament project of the Third Reich. In the nomenclature of the Wehrmacht it bore the code name "Hochwerk".

This complex, construction of which began in March 1940, was formally an offshoot of the IG Farben concern called "Anorgana". The other smaller factories were located in Gendorf, Falkenhagen (according to official information, with the exception of Brzeg this was the only factory that later produced organophosphates – in this case sarin) and Ammendorf near Halle. The main contractor was Luranil, but due to the size of the undertaking they had to hire no fewer than 28 subcontractors. Unqualified workers were supplied by the Gross-Rosen concentration camp, which, by the way, was mainly established in order to be able to serve the construction (cutting of tunnels) of armament facilities in Lower Silesia, located in the Owl Mountains, in Ksiÿÿ (Fürstenstein near Waldenburg), Leÿna (Marklissa), possibly in Krzeczyn (Kritschen) and other places. For this purpose barracks of the concentration camp Dyhernfurth I were erected near Radecz; In 1942 Dyhernfurth II was added.

These were possibly the harshest satellite camps of this concentration camp, which already had a very bad reputation, which is probably best illustrated by reports from prisoners. The following statements are from the articles "The criminals from Nixenhain" and "The heavily guarded camp" by W. Dominik, which were printed in the weekly magazine *Sprawy i ludzie* in 1986 :

> "'If prisoners covered themselves in the rain, snow and frost in autumn and winter or put a small blanket or an empty cement bag under their shirt or jacket, this was severely punished.' What were these penalties? Kazimierz Trzaska will never forget an incident in early December 1944 when his colleague Babski, a pharmacist from Vilnius, was punished: 'It happened on a Sunday morning. A strong wind was blowing and

it snowed. The prisoners went to work. At the main gate of the camp, Schneider, a German from Bessarabia, counted the prisoners as they left the camp in groups of five. Suddenly, a Gypsy foreman stopped in front of him, took off his cap and reported that one of the prisoners was wrapped in a blanket. The SS man immediately stopped the prisoner train. Babski was standing directly on the sidewalk. A piece of blanket peeked out from under his coat and jacket. Schneider kicked him in the abdomen with all his might. Babski fell to the ground. Schneider kicked him several times in the kidney area, and when Babski instinctively lay on his back, the SS man stood on his chest and kicked his face and ribs with his boot heels. When the unfortunate man gave no more signs of life, the SS man climbed down from the bleeding corpse, wiped his bloody shoes in the snow and calmly began counting the prisoners. […]' Some prisoners didn't want to wait for death. They tried to escape. There were ten escape attempts, only one of which was successful. The SS men failed to catch an eighteen-year-old. Unfortunately, the others were not so lucky. Wincenty Zagadaj describes the course of an escape in the summer of 1944 as follows: 'About nine o'clock in the morning the factory and camp sirens announced that an escape attempt had taken place. This was a signal for the people living in the area, who, according to an order from the German authorities, should stop their work immediately and set off with pitchforks, scythes and axes to comb through the cornfields, bushes and forest in order to find the To help SS men in apprehending the fugitives. We were called off work and taken back to the camp.

At around 4 p.m. the sirens wailed again, meaning the fugitives had been caught. In fact, the corpses of three prisoners, who were horribly beaten up, were brought to the camp's roll call ground. Judging by the wounds, their bodies were dismembered with shovels or other sharp tools.
Regardless, each of them had received a point-blank shot in the mouth since their heads were ripped apart

were. Even though I saw hundreds of corpses in Gross-Rosen, they were the first to be so macabre."

The prisoners were also used for armaments production themselves and as "guinea pigs" used:

"'Dyhernfurth I was a small camp with only 200-300 inmates. They were of different nationalities. Most of them were Poles, Russians, Germans and Czechs,' recalls Marek Wawrzyniak, a prisoner of the Gross-Rosen camp with No.
8391. 'The whole leadership was in two barracks, one built of wood and the other of brick. Both were fenced in with a double row of barbed wire that was live. Right next to the barracks there was a large workshop in which we filled artillery shells and aerial bombs with some stinking liquid. A siding ran along the hall. The hall itself was also fenced off with barbed wire, and the whole area was surrounded by a line of guards with SS men.' None of the inmates knew what this 'stinking liquid' was.

Prof. Dr. Andrzej Waksmundzki said the following: 'Although I'm a chemist, I didn't know the name of the gas that was used to fill the projectiles. It was only after the war that I learned that it was tabun through literature and the effects I still feel on myself today, as well as experiments conducted by Wrocÿaw scientists.

After the liberation, I learned from the foreign press that the stocks of Tabun-filled artillery shells and aerial bombs manufactured in Dyhernfurth I had been sunk by the Germans in the North Sea. The projectiles and bombs corroded and the gas they contained poisoned large numbers of fish. On the other hand, I learned from American publications that the production capacity of war gases in the Anorgana plant was said to have amounted to a thousand tons per month!' 1,000 tons is an enormous amount for Tabun. A concentration of 0.0005 milligrams in one liter of air is enough to poison the human body. This had to be Tadeusz Koral, a

Prisoner of the concentration camp with the number 10001, experienced firsthand: 'I was busy filling artillery shells with the poison gas Tabun. I always worked with a mask, as did the other prisoners, by the way. One day I was ordered to remove my mask and taken to a room where the bullets were being checked for leaks. This space could be sealed airtight. There were many projectiles ready for transport. I was ordered to sit on these missiles, then the door was hermetically sealed. It got completely dark. After a while I couldn't breathe and felt myself inhaling more and more gas. I became increasingly dizzy, passed out and lost consciousness.

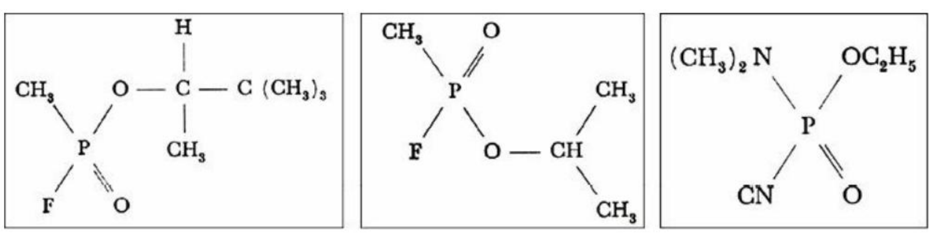
I came to on a table as small pills were placed under my eyelids. While I was passed out, I probably got an injection in my hand because I had a puncture. Ammonia was sprayed from a bottle around the table. I got a very bad headache, which was made worse by the fact that my pupils dilated violently from the pill and let a lot of light through. After that I was taken to the German part of the camp, where I spent several days lying down. No drugs were given to me, but I was given intravenous injections. I completely lost my sense of balance, could not move in a coordinated manner, and was plagued by sudden, severe headaches.

I was subjected to an identical trial in this room two more times. Once I was ordered to get into a car full of missiles and lock the door. I tried to open the window but couldn't. After an hour I lost consciousness. I was taken out of the wagon and given the same treatment as before.'" The complex in Brzeg caused problems for the local population even after the war:

“The tabun created by the Nazis during World War II in preparation for chemical warfare continued to pose a threat to people long after the war ended. Wÿadysÿaw

On October 30, 1947, Materny took over the position of chief engineer at the Rikita works, which was active in the field of organic chemistry and originated on the same site as the Inorgana complex. He recalls his first days on the job as follows: 'During the first period, which lasted about six months, the workforce rid the remaining facilities and buildings of the contamination of toxins which have a blinding and suffocating effect on the human body; the symptoms of poisoning typical of cyanide compounds occurred. During decontamination we encountered tabun sludge and 1% tabun solutions in chlorobenzene. During this work, workers who inhaled the tabun-contaminated air were repeatedly blinded. I remember that about ten times I was forced to drive several people to the Medical Academy clinic at the same time so that the doctors could give them help. Thanks to the immediate intervention of Prof. Falkiewicz and Dr. Wroniewicz, all workers were able to regain their sight.

By means of Prof. Dr. Using the method developed by Skrowaczewska, around 65 tons of chlorobenzene could be decontaminated. Tabun mud buried by the Germans around building No. 64 poisoned the groundwater for ten years, killing poultry and other animals of the residents of the village of Kraÿsko.



Structural formulas of the substances tabun, sarin and soman.

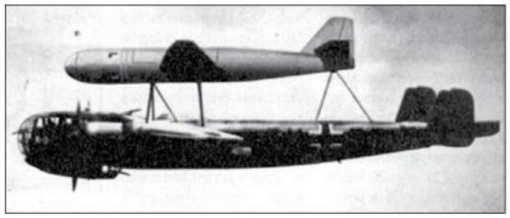
Based on the stocks of chemical raw materials (sodium cyanide, formamide, arsenic, phosphorus, chlorine, metallic sodium, methyl alcohol, ethyl alcohol, etc.) found on the plant premises, it can be assumed that the Anorgana plants also manufactured other chemical warfare agents in addition to Tabun or focused on their production

prepared. This is also proven by the huge ventilation system and the over 60 meter high exhaust chimneys, which were located in all production buildings. About a dozen tons of containers for chemical agents suitable for airdrops were removed from the factory premises.' The stored chemical substances would have been sufficient to synthesize war gases such as lewisite, yperite and others.
However, the Nazis failed to develop the Anorgana works into a powerful large-scale plant for the manufacture of deadly toxins - their plans were thwarted by the Red Army's rapid offensive. On January 20, 1945, all facilities in the Anorgana complex were shut down and construction personnel stopped all work. That was the end of the Anorgana companies, but the inmates of the Dyhernfurth I and II satellite camps were only now facing the most tragic days.”

The January offensive came as a surprise to the Germans, resulting in their inability to evacuate all supplies and machinery. However, the Russians obviously did not know about the prodigious supplies or simply did not have time to deal with them. For the Germans, however, it was inconceivable that such a huge arsenal could fall into Russian hands. They soon landed behind the Soviet troops, recaptured the Anorgana works, and planted underground explosive charges, the detonations of which were felt in a radius of many kilometers. The officer in charge of this operation was received by Hitler like a national hero and decorated with the highest decorations.

Before the end of the war, however, the Germans managed to start limited production of even more potent toxins than tabun, primarily sarin and soman, in Brzeg. However, it should be borne in mind that no less than 8,770 tons of tabun were produced (6,400 tons of which were placed in missiles, bombs and aircraft spreaders), but only 1,260 tons of sarin (of which 300 tons were in missiles and bombs) and of sarin only 20 tons, mainly due to the great chemical instability of this substance. It was also with the limited production

three other substances, designated T-150, T-155 and T-300, which were cyanide compounds. Similar to Soman, they were not filled with ammunition either.



Combinations such as these were considered as means of transport for chemical weapons. The picture shows the DFS-228 glider with additional rocket propulsion, carried by the Do-217 bomber. (photo from the author's collection)

The production of combat toxins in the Third Reich gradually increased from the beginning of the war and reached its peak in early 1942, when about 800 tons were delivered monthly. Then there was a decline, which among other things was the result of air raids. A slow increase was not registered until early 1943, finally reaching a level of almost 1,000 tons per month in the summer.

The substances tabun, sarin and soman developed in the Third Reich are still among the most dangerous toxins of all. Even the greatest post-war achievement in this field, namely substance VX, which was added to the American arsenal in the 1980s (all stocks were later destroyed), was merely a further development of the substances mentioned above.

It is amazing that it was not until 1944 that the Germans fully realized the importance of the chemical weapons production program and began to see an opportunity in saving the Third Reich. In his "Memoirs", Speer describes the considerations that accompanied this process: "In the late

> autumn of 1944, Hitler interfered in the manufacture of gas masks by appointing a special representative who had to report directly to Hitler. A plan to protect the entire civilian population from gas attacks was developed in great haste. Although Hitler's emergency order of October 1944 had led to a tripling of production and 2,300,000 gas masks were then manufactured, they could only be completed within a few

Months to be distributed to the inhabitants of the cities. Therefore, the party organs published recommendations to use primitive means of protection (e.g. paper).

Although Hitler was talking about the danger of an enemy gas attack on German cities at this point, my friend Dr. However, Karol Brandt, who had been commissioned to carry out protective measures, did not rule out the possibility that we could unleash a gas war with such hasty preparations. In the arsenal of our 'wonder weapons' was a poison gas called Tabun; it could pass through the filters of all known gas masks, and even minimal doses resulted in death.

After the meeting in Sonthofen, I was invited to his saloon car by Robert Ley, who was a chemist by trade, in the fall of 1944. We sat with a glass of wine, as was his custom.

His stuttering showed great excitement: 'But we have this new poison gas, I heard about it. The leader has to do it. He must use it. He must do this now! So when! It is five to twelve!

You too should tell him it's high time!' I said nothing, but Ley was most likely having an identical conversation with Goebbels, because the latter questioned employees in the chemical industry about this poison and its effects and also interceded with Hitler to plead for the use of the new gas. Although Hitler still rejected a gas war, during a briefing at headquarters he gave it to be understood that a gas operation in the east could stop the onslaught of the Soviet troop formations. In doing so, he made the confused musing that the West would accept a gas war against the East; at this stage of the war, the British and American governments are interested in stopping the Russians."

At the same time, as we know, combat vehicles were being modified to be operational in the event that chemical weapons were used.

* * *

Although since the end of World War II over a half

century has passed, the program described still raises many questions.

Among other things, the question of the means of transport for chemical weapons and the operational plans for their use have not been clarified – the production of the chemical substances themselves must have been accompanied by other measures of a comparable extent. A corresponding armaments program (means of transport) and plans for military operations could be expected, but knowledge about them is very incomplete. The examples of the biological and nuclear program show that the solution to the questions of means of transport was worked on in parallel and that these areas were inextricably linked. We know e.g. B. that there was a dedicated bomber squadron for biological weapons.

However, that is not all.

The increased interest in the chemical program apparently resulted in a feverish expansion of the chemical weapons production industry, primarily in the guise of underground factories - a fact very little known today. It turns out that, apart from Brzeg Dolny, there were several such (later forgotten) complexes in Lower Silesia alone. Among other things, this concerns the mining complex in Ludwikowice Kÿodzkie (Ludwigsdorf). During the war it was used for the production of armaments, including chemical weapons, as large quantities of them were later found in this place. To this day, a large part of it is walled up in surrounding bunkers, as evidenced by appropriate warning signs.

A few years ago I talked to Bogusÿaw Wróbel from the editorial board of the *Eksplorator* magazine , a specialist in underground complexes in Lower Silesia. He told me that one of the mines in Waÿbrzych (Waldenburg) had been converted into a large chemical factory during the war, employing thousands of people and of great importance. It was called "Glückhilfsgrube". I found some information on this topic in the archives of the Institute of National Remembrance (IPN) in Warsaw.

It was actually a large complex of special importance, which used, among others, Polish forced laborers and Russian prisoners of war, housed in nine labor camps and many scattered buildings. It's amazing that the

Germans all the time until the end of the war tried at all costs to increase the number of workers. Even during the Soviet January offensive in 1945, the captured soldiers (in Lower Silesia) were sent to the "Glücksgrube" as a matter of priority. Employment peaked on April 1, 1945 (2,945 people). I have not found any direct information about the purpose of the work done there; however, one of the documents indicates that there was a laboratory in the complex. There was also a large, modern high-pressure power plant, which was expanded in December 1944 - including the installation of five new boilers.

I received confirmation of the information provided by Bogusÿaw Wróbel in September 2001 when Father Marzÿda, the deputy commander of the Waÿbrzych State Fire Service called me. He noted that since the recent flood, "unusually large" amounts of toxic gases have been escaping from the sewage system on ÿw. Józefa Street - chlorine and ammonia, among others, have been detected. It was mainly the area surrounding the elementary school, which is located on the street mentioned above. Marzÿda asked me if I could guess what chemical substances to expect next. Of course, I didn't know the answer to that. The source of the leakage was soon identified. It turned out that the - school on ÿw. Józefa Street stands on a concrete plug that the Germans used to block access to one of the shafts leading to the underground "Glückhilfsgrube".

During the flood, the water partially filled the subterranean spaces and carried the deadly gases to the surface, including through the old and brittle sewer network. Similar incidents also occurred during the previous flood in 1997.

I learned about another work from a resident of Wrocÿaw. He found out that a Tabun factory stood on what is now Krakowska Street during the war. The factory is currently called "Coussons" (formerly "Pollena"). After the war, Prof. Drobner is said to have dealt with this issue. According to his associates, a large number of containers with tabun locked in metal barrels were found there. Allegedly, they were later buried at a factory site on Oÿawska Street.

In particular, these facts suggest that the quantity of 10,000 tons of organophosphate-based chemical weapons released in the

Third Reich are only part of the truth. The above quantity refers to the factories in Brzeg Dolny (Dyhernfurth) and Falkenhagen. However, this bears no relation to the mines in Ludwikowice and Waÿbrzych. It is well known that the latter alone employed more than 2,000 people in connection with armaments production. On the other hand, we know that about 200 people were needed to operate the production line in Brzeg Dolny, which produced about one ton of Tabun per day.

It can therefore be assumed that with the declaration of "total war" the pace of production of chemical weapons increased significantly and the production volume in Brzeg Dolny and Falkenhagen possibly significantly exceeded. Of course, we can no longer speak of "only" 10,000 tons. Despite the end of the war, the discrepancy with official data may not have surfaced since many underground factories were under SS control; thus they worked outside of the official administration and often without the knowledge of Speer's Reich Ministry.

nuclear weapons

Contrary to my own expectations, this chapter differs significantly from the rest of the book. Many readers may be surprised that I do not describe the course of German work on atomic fission here; However, the existing publications contain so many ambiguities or even contradictions that the available information is difficult to put together to form a uniform picture.

First, I intended to begin this chapter by stating that what is commonly thought of as the "German nuclear weapons program" actually had very little to do with the development of the atomic bomb. The funds allocated for this purpose (at least those that we know of) were very modest compared to, for example, the USA; unlike the United States, the Germans never went into the industrial phase of nuclear fission. It is a misunderstanding to speak of a German atomic bomb and shows ignorance of fundamental facts.

So that was the starting point of my reflections on this historical aspect, long before I had started to collect and analyze the material myself. However, after evaluating it, I realized that I could never take responsibility for the above claim - and my perspective has changed...

First of all, it should be borne in mind that German research in the field of nuclear engineering was carried out by many **independent groups** of scientists operating within the framework of various institutions (from individual institutions to the Post Ministry itself). This was reflected in the fact that in the field of nuclear research there were a great many laboratories and other scientific institutions scattered all over the Reich. One of the problems is that we certainly know nothing about many of them, so the full extent of German nuclear research is unknown and likely never to be ascertained

will. There are simply too many "blank spots" on the map.

From interviews I once had with people years ago who had researched this set of issues on the basis of intelligence documents, it appears that the town of Torgau played a very important role in the German nuclear research program. A facility for the enrichment of fissile materials was probably built there in 1944, which was "legendary" as a water treatment station. In today's publications, however, this fact remains unmentioned.

No one mentions the role of an underground facility in Ksiÿÿ either (Fürstenstein near Waldenburg), although on the German map this location is marked with the fissile material symbol of the time (three overlapping circles).

Completely disregarded is the role of the nuclear laboratory at nearby Kowary (Schmiedeberg), where an electrolysis plant for the production of heavy water was established at the end of the war; 20 cm thick (!) lead plates and a number of small tubes, probably made of cesium, were found in a nearby underground facility.

A report from the Red Army intelligence service, which is shown in the "War Decisive" part, contains another unresolved element that evokes associations with some kind of nuclear weapon (it's about a concept that was realized in the Thuringian "Mittelwerk" even before the V2 was built had been).

Here is another clue: in 1995, *Przeglÿd Techniczny* magazine printed a list of former German, mainly underground, facilities located on Polish territory. [124] This is probably a document from the former Ministry of Industry and Trade from 1953. Apart from such oddities as e.g. B. the description of the underground facility in which "phosphorescent walls were used for lighting" can also be read therein about an underground ammunition factory in which the Germans carried out tests with **nuclear weapons** " (point no. 42). In the" rubric with information on the location is given "Nowogard (Naugard) district, Marty (Sobótka) town". Nowogard suggests the surroundings of Szczecin, but I couldn't find either the place Marty or Sobótka in this region - in 1953 many unofficial names were still in use, which were sometimes changed several times. This example must be absolutely no exception

represent. The entrances to the top-secret underground research facility were blown up in 1945, bringing its history to a definitive end. (Author's note: The German name of the place was Speck, today's Polish name Mosty - see also the map at the beginning of the book.)

A similarly mysterious core lab is revealed in the ones below It was described in the Operation *Lusty* files . a place called[125] located in Linnessrabe or Linnesgrabe (one letter is almost illegible) and was destroyed shortly before the end of the war. The report only states that a "fierce" officer would be needed to interrogate the staff if necessary. This laboratory is also not described in any of the generally available documents, nor does anyone know what happened to it. Who guarantees that there weren't many other, similarly hidden elements in the German nuclear research program?

Of course, all this does not mean that the results of this program were different from what is generally assumed, and that work on an atomic bomb was actually completed. On the other hand, one of the reports includes a description of a German nuclear weapon explosion... It is a summary of intelligence information prepared by the US Strategic Air Forces in Europe staff. 126 This report was classified as top secret at the time. The description of the explosion came from Zinsser, a German test pilot and anti-aircraft missile expert. While he was the only witness, his description is fairly detailed and fully corresponds to the depiction of an actual nuclear explosion. The report is dated August 19, 1945, so it was written almost two weeks after the explosion over Hiroshima, although the testimonies were undoubtedly written before August 19.

There was no way that Zinsser (even after August 6) could know all the details of the "Japanese" explosion, because he didn't see it on satellite TV - at that time such incidents were kept secret. Here is his report:

> "At the beginning of October 1944 I took off from the airport in Ludwigslust (south of Lübeck) and was about 12-15 km from the nuclear test site [?! – note d. Author's] removed when I had a strong

brightening of the whole atmosphere, which lasted about two seconds. [The specified duration of the fireball corresponds to an explosion with an explosive force of about five to ten kilotons - ed. author]

The overpressure wave was very visible and propagated beyond the area of the cloud that had formed as a result of the explosion and was now following the overpressure wave. When the overpressure wave became visible, it was about a kilometer in diameter and the cloud often changed color. After a short period of darkness, various colored patches became visible on this cloud, which were pale blue in color in contrast to normal explosions. After about 10 seconds, the previously sharp outlines of the blast cloud began to blur and gradually brightened against the background of gray cloud cover. The overpressure wave, which was visible for about 15 seconds, was about 9,000 meters in diameter.

I could observe that the blast cloud now had an almost blue-violet hue. At this time their red edges became visible, which suddenly turned a 'dirty' color. In my observation plane I could feel a slight reaction heat in the form of attracting and repelling movements. This turbulence, which gave the impression of atmospheric disturbances, lasted about 10 seconds without exceeding a clear peak.

Linnes:rabe	26 April 45.	Under consideration for investigation. The assessros suggest that a <u>fierce</u> int rrogater is re uired.	Research on nuclear phys. could have possessed 20 million volt deuterons cyclotrons but for destruction of the lab a few weeks ago. Almost completely destroyed.

Fragment of a documentation of Operation *Lusty,* with a brief description of one of the core research laboratories.

About an hour later I took off in a He-111 from the airfield in Ludwigslust and flew in an easterly direction. Shortly after takeoff, I flew through very dense cloud cover (at an altitude of between 3,000 and 4,000 m). One hovered at an altitude of about 7,000 meters

mushroom-shaped cloud, with turbulent, coiled parts. She was above the blast site, but with no clear connections [to her? – note d. author]. There was severe electrical interference and it was not possible to maintain radio communication, like after a lightning strike.

Due to the presence of P-38s in the Wittenberg-Merseburg area, I was forced to fly north, which gave me a better view of the lower part of the blast cloud.

Caution: It is not entirely clear to me why such experiments were carried out in such a densely populated area." I am inclined to think that the above description is a misunderstanding. But make no mistake - we don't know everything about German wartime nuclear physics.

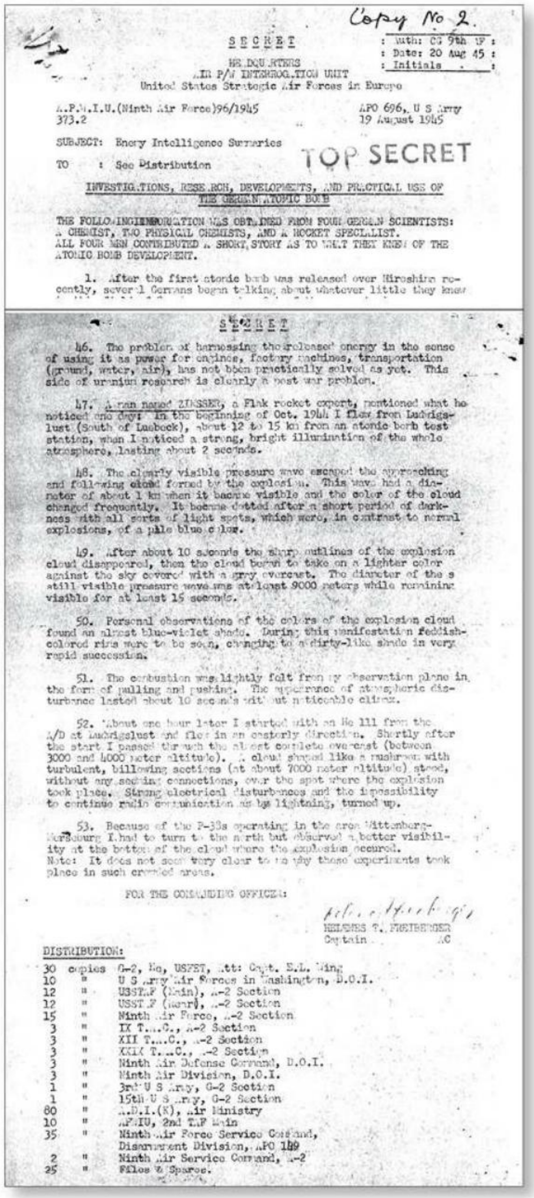
We must also be aware that the term "nuclear physics" is very broad and includes areas that have nothing to do with the atomic bomb. We know e.g. B. that nuclear research facilities that had particle accelerators (betatrons, cyclotrons ...) were used primarily for research on "death rays". Some used their stores of radioisotopes to make bright paints that coated aircraft instrument needles and painted the "phosphorescent walls" mentioned earlier. Research into controlled nuclear fusion has also been undertaken (but doomed to fail), e.g. B. in Prague and at the Berlin Kaiser Wilhelm Institute. After the war they continued on the Argentine island of Huemul.

So it cannot be ruled out that what is generally referred to as the "German nuclear research program" was actually a conglomerate of very different research areas.

The fact that there were obviously many more laboratories in the Third Reich dealing with the broad field of nuclear physics than are mentioned in books on German research work, and that these institutions were not connected with one another, was by no means an expression of organizational chaos (as some suggest), but rather the hallmarks of a certain administrative system. This system

comprised the most secret research work and was intended to make it more difficult, if not impossible, to spy out them. As you can see, this goal has been achieved. The Allies never understood the character and aims of the research conducted in Mosty, ÿroda ÿlÿska (Neumarkt in Schlesien – described below), Kowary (Schmiedeberg), Linnesgrabe, etc. Therefore, after the war, the Americans were not at all interested in hiring German nuclear researchers. They didn't know that these scientists were also taking other, new and therefore interesting paths. Even today, researchers obviously find it difficult to fully grasp this complex of topics. Such a system is called segmentation and is based on dividing the different branches of a research area very strictly. There was e.g. B. Cases where the names of key scientists have been kept secret and used exclusively 'internally' within an institution. Other names were used for correspondence with other bodies or central institutions.

Such a system of management for the field of nuclear physics (and for some other fields) was later adopted by the Americans, many years after the war, when they developed their own "black projects".



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19 August 1945

SUBJECT: Enemy Intelligence Summaries

TO : See Distribution

TOP SECRET

INVESTIGATIONS, RESEARCH, DEVELOPMENTS, AND PRACTICAL USE OF THE GERMAN ATOMIC BOMB

THE FOLLOWING INFORMATION WAS OBTAINED FROM FOUR GERMAN SCIENTISTS: A CHEMIST, TWO PHYSICAL CHEMISTS, AND A ROCKET SPECIALIST. ALL FOUR MEN CONTRIBUTED A SHORT STORY AS TO WHAT THEY KNEW OF THE ATOMIC BOMB DEVELOPMENT.

1. After the first atomic bomb was released over Hiroshima recently, several Germans began talking about whatever little they knew

S E C R E T

46. The problem of harnessing the released energy in the sense of using it as power for engines, factory machines, transportation (ground, water, air), has not been practically solved as yet. This side of uranium research is clearly a post war problem.

47. A man named ZINSSER, a Flak rocket expert, mentioned what he noticed one day: In the beginning of Oct. 1944 I flew from Ludwigslust (South of Luebeck), about 12 to 15 km from an atomic bomb test station, when I noticed a strong, bright illumination of the whole atmosphere, lasting about 2 seconds.

48. The clearly visible pressure wave escaped the approaching and following cloud formed by the explosion. This wave had a diameter of about 1 km when it became visible and the color of the cloud changed frequently. It became dotted after a short period of darkness with all sorts of light spots, which were, in contrast to normal explosions, of a pale blue color.

49. After about 10 seconds the sharp outlines of the explosion cloud disappeared, then the cloud began to take on a lighter color against the sky covered with a gray overcast. The diameter of the s still visible pressure wave was at least 9000 meters while remaining visible for at least 15 seconds.

50. Personal observations of the colors of the explosion cloud found an almost blue-violet shade. During this manifestation reddish-colored rims were to be seen, changing to a dirty-like shade in very rapid succession.

51. The combustion was lightly felt from my observation plane in the form of pulling and pushing. The appearance of atmospheric disturbance lasted about 10 seconds without noticeable climax.

52. About one hour later I started with an He 111 from the A/D at Ludwigslust and flew in an easterly direction. Shortly after the start I passed through the almost complete overcast (between 3000 and 4000 meter altitude). A cloud shaped like a mushroom with turbulent, billowing sections (at about 7000 meter altitude) stood, without any seeming connections, over the spot where the explosion took place. Strong electrical disturbances and the impossibility to continue radio communication as by lightning, turned up.

53. Because of the P-38s operating in the area Wittenberg-Merseburg I had to turn to the north but observed a better visibility at the bottom of the cloud where the explosion occured.
Note: It does not seem very clear to me why these experiments took place in such crowded areas.

FOR THE COMMANDING OFFICER:

HELMES T. FREIBERGER
Captain AC

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Fragment of the American report quoted in the text.

To a certain extent, the Germans were forced to develop such solutions, if only because they used a large number of foreign workers, prisoners and companies from conquered countries for their war machine. They had an easier task in that, firstly, the prisoners were bound to the secrets entrusted to them for life (the rather metaphorical term "secret bearer" was used, meaning that the individual is part of the secrecy system and bound to the secret forever bound

remain); the other key element was the SS, since this "institution" had not only appropriate (e.g. underground) facilities, but also its own manpower and sources of funding. In special cases, the Germans could actually ensure that no information was leaked out at all.

This is also why so many institutions have only been superficially explored, only their names are known, or their role is misunderstood to this day, especially in the West. This also results from the fact that German nuclear research is mistakenly understood as a kind of counterpart to the American Manhattan Project. This overlooks the fact that the "building of the atomic bomb" was not the primary goal of this research - in any case, it was not the only one.

The mode of action of the "segmentation" can also be explained using the example of a German concept for the construction of a graphite reactor. To this day, this project escapes the attention of specialists, although the decision to build such a **full-scale reactor was** made back in 1941. The biggest challenge in this case was to produce suitable graphite blocks. The former carbon electrode factory (which was renamed “Plania Werke” after the takeover by Siemens) in Racibórz/Ratibor was commissioned with this task. In the final weeks of 1941, Prof. Bothe and Prof. Harteck ordered **a hundred** unusual blocks, each three meters long and 60 cm wide.

They attached great importance to the purity of this material. However, a situation arose that was unusual in the Third Reich, at least in the then "victorious" period: the main technologist of the works, a German by the name of Erwin Schmidt, turned out to be an anti-fascist. The job seemed suspicious to him, although he knew nothing about the construction of the nuclear reactor. Therefore, he deliberately chose a raw material contaminated with pyrite and lime compounds. This sabotage turned out to be very effective. Incidentally, due to a strange twist of fate, the physicists could not find out why their reactor was not working and rejected further work **for almost three years.**

It was precisely at this point that the Greater German Reich was losing its edge over the Americans (mainly the Europeans employed in America, to be precise), marking a turning point in the history of German nuclear research and the whole war.

However, the principles of segmentation meant that this episode, along with all the other pieces of the puzzle (ie, the whole project) got lost in the great information buzz, as if it had never existed.
Certain white spots in the history of secret German concepts will therefore never be cleared up.

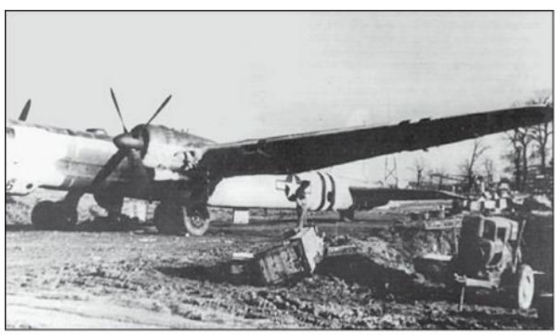
One more addendum. In Albert Speer's "Spandau Diaries" I found an interesting excerpt showing that Hitler, despite everything, considered the possibility of the destruction of New York to be real; it is clear from the context that he had nuclear weapons in mind: “I was wondering if

> there are temperaments that can be linked to certain elements. If so, I would have no hesitation in saying that Hitler's element was fire, although what he loved about fire was not its Promethean aspect but its destructive power. That he set the world on fire may only be an idea. However, fire itself, both literally and figuratively, always provoked unusual excitement in him. I can remember his demonstrations in the office; Films that showed burning London, a sea of flames over Warsaw, exploding convoys - and the excitement with which he followed these films. I have never seen him so impressed as at the end of the war, when he imagined in a kind of delirium the destruction of New York in a firestorm.
>
> He described skyscrapers turning into gigantic flaming torches and collapsing, the glow of the exploding city illuminating the dark sky. Then, as if coming back to reality from his madness, he announced that Saur must immediately implement Messerschmitt's concept of a long-range four-engine bomber. With a reach like that, we could pay America a thousand times over for destroying our cities.”

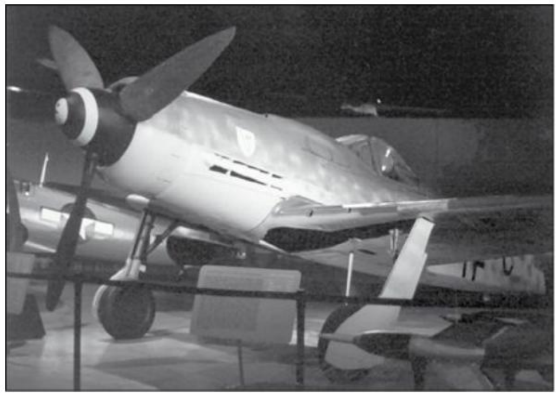
American technology drainage through operations "Paperclip" and "Lusty"

At the end of 2001, I had a rare opportunity to get acquainted with the central archives of the American air intelligence service at Wright Patterson Air Force Base, where after the war one of the post-war places where the captured German documentation and specimens of the most interesting designs were kept was established were managed (at that time it was still called "Wright Field Air Base"). You have to know that the American intelligence service did not plunder everything at random. Only tidbits were brought there, and the greed and admiration with which this was done was the best advertisement for German wartime achievements. Of course everyone else did the same

...

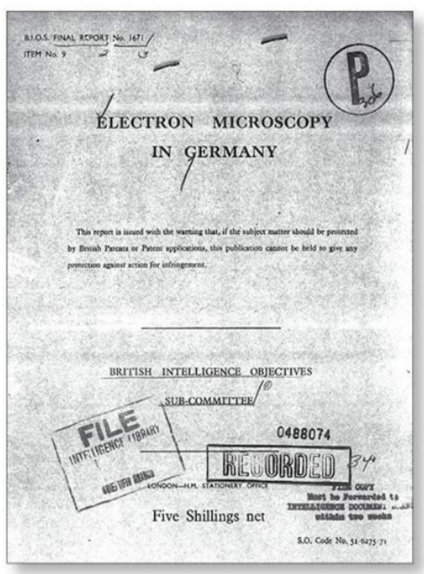


The German He-177 heavy bomber after being shipped to the United States.
(Photo: archive)



A Focke-Wulf FW-190 - captured by the Americans.

The base I mentioned contained, among other things, the files I consulted about Operation *Paperclip,* which went hand in hand with the American technology drainage.[127] As part of this operation, the most important specialists of the Third Reich were brought to the USA, while those who dealt with aeronautical engineering were taken to Wright Patterson AFB near Dayton, Ohio. These were the elite of German and Austrian scientists and technical experts.



B.I.O.S. FINAL REPORT No. 1671

ITEM No. 9

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ELECTRON MICROSCOPY IN GERMANY

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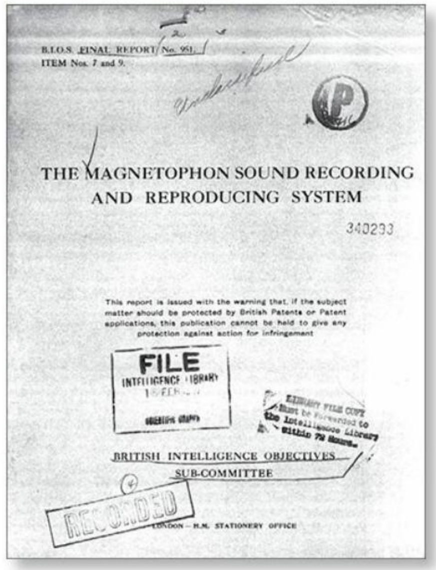
B.I.O.S. FINAL REPORT No. 951.
ITEM Nos. 7 and 9.

THE MAGNETOPHON SOUND RECORDING AND REPRODUCING SYSTEM

340293

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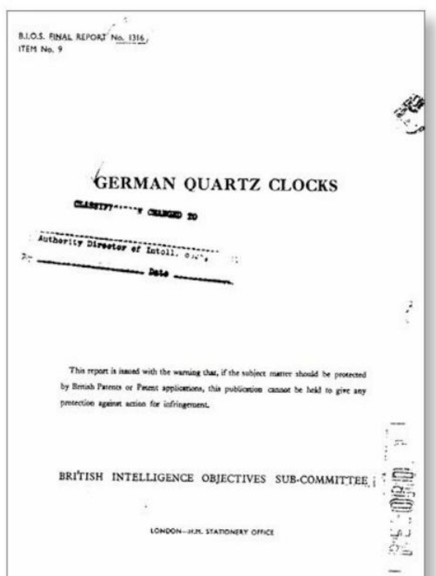
The Allies were primarily interested in the most advanced German technology. Shown are covers of selected UK Intelligence reports on electron microscopy, tape recorders, quartz watches and semiconductors. (NARA/BIOS)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ITEM No. 9

GERMAN QUARTZ CLOCKS

Authority Director of Intell.

Date

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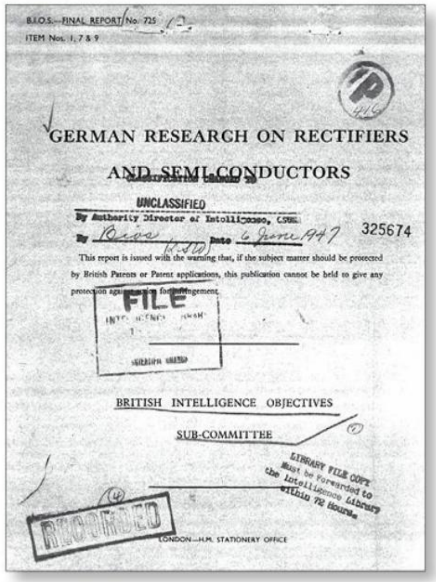

B.I.O.S.—FINAL REPORT No. 725
ITEM Nos. 1, 7 & 9

GERMAN RESEARCH ON RECTIFIERS AND SEMI-CONDUCTORS

UNCLASSIFIED
By Authority Director of Intelligence, CSUM
By Bios (R.S.W.) Date 6 June 1947

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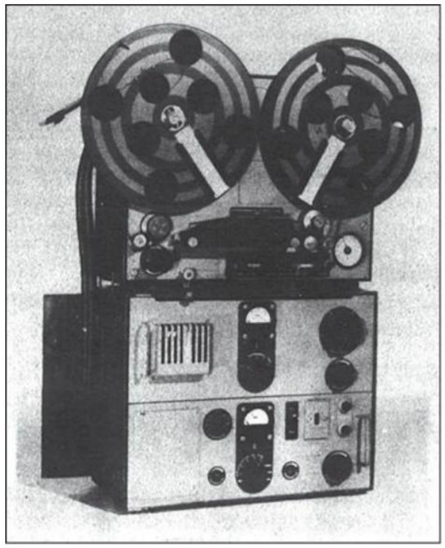
On February 3, 1948, American General Joseph T. McNarney, Commander-in-Chief of the Air Force Material Command, wrote that German specialists overseas made a significant contribution to the realization of scientific research work and made it possible to "resolve the very critical deficit of highly qualified specialists". to alleviate. On the 27th. February of the same year, the Air Force Secretary described Operation *Paperclip* as a "sensation". It is estimated that just this one operation accelerated scientific progress in America by two to ten years, and that the savings on the missile program alone amounted to "at least $750,000,000." 127 Americans may have been unaware (or just unwilling) of the fact that they were profiting from forced labourers, concentration camp prisoners and patents stolen by Germans in conquered Europe.



The German tape recorder *Tonschreiber-B* from the late 1930s, the harbinger of a whole new field - electronics. The bottom part of the device is an amplifier.
(Photo: BIOS)

By December 4, 1946, 270 professionals had been brought to the United States. After the first assessment of the results of their work, the Americans decided to move about 700 more people. About 100 of them worked at Wright-Patterson Air Force Base around the turn of the year 1946/47. They were paid between $2.70 and $11 a day, which was deliberately lower than the earnings of American civil servants. As part of this operation, 1,200 tons of technical documentation were intercepted in the Third Reich, of which around 150 tons were shipped to the USA after a selection. The Americans paid no attention to the fact that many documents had the words “Heil Hitler!” under the signatures of the authors. Both the documentation and the experts were later housed in three main American bases, namely Wright Field / Wright-Patterson AFB, at the White Sands Missile Range missile test site in the state of New Mexico, and at Freeman Field AFB in Indiana, — where the lesser known part of the German concepts in the field of aviation and their authors were brought. Some of the scientists were "scattered" across various scientific military research institutions and universities.

In addition to the prototypes of various aircraft, such. B. the Me-262 and the Je-290, among others, the following people were brought to the premises of the base in Ohio:

• dr Hans Mayer - former director of the Berlin works of Siemens and Halske - the only one of them who was undoubtedly anti-fascist and imprisoned in five concentration camps; • dr Hans Eckert - Thermodynamicist who used to work at the Aeronautics Research Institute in Braunschweig. He made an important contribution to the development of jet and ramjet engines by developing the necessary high-temperature alloys;

• dr Heinz Schmidt - co-designer of the German jet engines; • Prof. [the Americans indicated “Dr.” here – ?] Alexander Lippisch. As it turned out in the USA, he not only developed the Me-163, DM 1, P-12 and P-13, but was also involved in the development of a German space station. The ··· Americans showed great interest in this area. As follows from the Operation *Paperclip* documentation , Lippisch was brought to the United States along with his prototype of a modern fighter, but what type it was was not specified. It is only from the files of Operation *Lusty ,* described below , that it emerges that the aforementioned P-13 was involved. Lippisch was the focus of attention at Wright Field as he was considered the foremost authority on supersonic aircraft - lecturing and conducting seminars on the subject.

According to US Air Force officers, Lippisch's achievements, far ahead of their own, revolutionized American understanding of the subject in an unprecedented way. Senator Harry F. Byrd spoke of "revolutionizing the very nature of air warfare," and General Donald L. Putt, in a newspaper interview attached to the filing, stated the following: 127

> "The progress of their [the German] research work in the field of jet and rocket propulsion, aerodynamics, the
> thermodynamics, supersonic flight physics and other areas

was clearly way ahead of our performance. However, I do not believe that the Germans are inherently more talented than the best American scientists and engineers. Finally, we developed the atomic bomb. The difference, to use pilots' language, was that while we made a great deal of progress in the field of conventional development, the Germans blazed an entirely new trail in the field of aeronautics and made it viable.” [Emphasis added]

By the way: Of the most important scientists who worked on the American atomic bomb, only Feynman and Oppenheimer were Americans. For some of these bombs, German fissile materials were also used, which came from the intercepted evacuation transports.

Other scientists "imported" to Wright Field include:

• Fritz Doblhoff – a young, then 30-year-old, designer of the WNF 342 rocket-propelled helicopter. He was brought to the base along with a prototype of this machine; • dr Helmut Heinrich, former employee of the "Graf Zeppelin Research Institute". Using a vertical wind tunnel installed there, he developed the so-called ribbon parachute, which was reminiscent of a normal parachute, but was sewn together from ribbons that were separated from each other by slits. It proved itself excellently at high flight speeds and heavy loads.

It made it possible to slow down a heavy aircraft just before landing, or to catapult the pilot even at high speeds and at low altitudes (nota bene, the Germans were the first to use ejection seats). Thanks to the parachute developed by Heinrich, test specimens of remote-controlled rockets (including the V2) with undamaged electronics could be recovered, which the Americans couldn't handle at all;

• dr Theodore Zobel. During the war he headed the wind tunnel in Braunschweig, where he further developed the so-called Schlieren interferometer, which made it possible to determine the pressure distribution around t

to precisely determine the aerodynamic profile based on the measurement of light interference. The device also made it possible to determine the temperature profile inside a rocket engine nozzle at a distance. According to Zobel himself, in this way data could be collected within a thousandth of a second, for which 250 classic pressure and temperature point measurements would have been necessary. acco Wattendorf, one of the American scientists at Wright Field, this invention accelerated American research in the field of aerodynamics by about five years;

• dr Rudolf Hermann – an employee of the research complex in Peenemünde. He made an important contribution to the development of the rockets created there and built a number of supersonic wind tunnels. At the end of the war he was even in the process of building a tunnel in Bavaria with a flow rate of 11 km/s, which of course was groundbreaking at the time. Hermann was significantly involved in the development of the ICBM A9/A10 and examined their model in the wind tunnel. He came to the United States with a group of seven collaborators and a large number of elaborations still unknown to Americans;

• dr Ernst Steinhoff and Dr. Martin Schilling - rocket experts, co-designers of the A9 rocket;

• dr Bernhard Goethert - an aerodynamicist, developed wings for jet aircraft, his knowledge was considered the key to the development of supersonic fighters;

• dr Richard Vogt - the main designer of the Blohm-und-Voss concern, author of many unconventional jet concepts;

• dr Rudolf Edse - in the last years of the war he led research work on new rocket fuels (Brunswick). In this area, the Americans were just beginning;

• dr Otto Gauer - he was the first to implement a broad research program that dealt with the biological consequences of flights at high altitude (hypothermia, lack of oxygen) and at high speed (acceleration stress, tunnel vision effect). He was soon joined by Prof. Hubertus Strughold, another great in the field.

The above names are just examples from an area that represented **only a part** of Operation *Paperclip* , although this operation was not the only one of its kind. It would be interesting to see how it compares to what other countries are doing.

Well, the Americans did not take over most of the technical developments, nor most of the professionals, but in terms of quality they certainly took the first place. This arose not only from the capacity of their technical intelligence service, but from the simple fact that leading scientists on the surrender were more in the American than e.g. B. wanted to be located in the Soviet zone of influence. It was the same with von Braun, who, after the evacuation to Oberammergau, made himself available to the Americans together with documentation and a large group of designers who accompanied him; or at dr. Anselm Franz, the main designer of the Junkers works in Dessau. Neither the Americans nor the British, on the other hand, hired a single German nuclear physicist because they feared that the work would be kept secret. Incidentally, the British fared fairly modestly in this regard. The comparatively weak technical news service had an influence on this, but above all the extreme economic crisis, which forced them to drastically restrict scientific research.

For this they hired Hans Multhopp, probably the most important German aerodynamicist.

Doblhoff's helicopter in American hands. (Photo: NAIC)

The Soviet technology drainage, on the other hand, had a completely different character than the American one. The Russians were not able to attract particularly many of the highest-ranking experts.
Exceptions were Dr. Ferdinand Brandner, a designer of jet engines (the engines Jumo-004 and BMW-003 were later

copied as RD-10 and RD-20), Brunolf Baade, a designer of Junkers jet aircraft, or the engineer Hans Ressing from Siebel. The Russians, on the other hand, took over entire laboratories and factories and, after dismantling them, brought them to their premises, trying to take as many staff as possible with them. Because of the USSR's great backlog in many areas, the Russians were also interested in average to low-skilled personnel. In this way, Operation *Ossawakin* (this alias appears in the Operation *Paperclip* files) transferred more people than all other countries combined. The German Research Foundation in Berlin estimated their number at around 5,000 based on laborious studies carried out in the second half of the 1980s.

However, many high-ranking experts also ended up in Argentina, where they were either evacuated or simply travelled. The top group included 60 university lecturers, about a hundred aviation experts (Reimar Horten, Kurt Tank, Ludwig Mittelhuber, Ulrich Stampa, Otto Pabst, Julius Henrici, Klage...) and about a dozen nuclear researchers, above all Ronald Richter, Heisenbergs, who worked on thermonuclear fusion assistant dr Guido Beck, the co-author of the concept of the German atomic b Decker, the wartime controlled nuclear fusion worker Dr. Walter Seelmann-Eggebert, the engineers Gans and Hellmann from AEG and many others. It was also planned to transfer Heisenberg, but this plan was prevented by the Allies.

Some German experts stayed in Spain after the war, where, like in Argentina, they continued their wartime research.
These included Prof. Willi Messerschmitt (Malaga), Dr. engineer Claudius Dornier (Madrid) and a group of designers who developed the MP-43 carbine. I refer readers interested in these matters to my book on the German evacuations of 1945.

* * *

As noted, *Paperclip* was not the only US intelligence operation linked to the

technology drainage of the Third Reich. In early 2002 Nick Cook, my UK colleague from *Jane's Defense Weekly magazine,* sent me a copy of a detailed documentary on an operation similar to 125 Ich *Paperclip ,* codenamed *Lusty*. must admit that this material is so sensational that it gives the impression of a novel from another planet.

I have been dealing with these topics for a long time and know the people who used to have access to the relevant secret material. Nonetheless, the content of the Operation *Lusty* documentary was something completely new to me and to everyone else I had spoken to about it. The material consists of a descriptive part and a list of facilities / intelligence targets in the occupied Third Reich. In the descriptive part, for example, there is talk at the very beginning of intercepted German evacuation transports using submarines (unfortunately in an abbreviated form). These are facts that not only shed a whole new light on the end of the Second World War and the question of the scientific and technical achievements of the Third Reich, but which are particularly shocking because attempts are still being made to keep them secret !

Below I present a translation of excerpts from the documentation mentioned above, keeping my comment to a minimum: 125

[Microfilm clip 590]

"In a medieval inn near Thumersbach near Berchtesgaden, at the beginning of May 1945, the Luftwaffe General Staff waited patiently for the outcome of the peace negotiations that were to be decided in the north. In the last few weeks they came here by car and plane when the fall of Berlin proved inevitable and maintained radio contact with Admiral Donitz in Flensburg. Their location, which was previously unknown, was determined by wiretapping. Within 24 hours, Colonel O'Brien, representing the Exploitation Division of the Directorate of Intelligence, USAFE, and his small force had reached the appropriate location, located the staff, and were leading

the first in a series of conversations with General Koller, who was then the supreme commander. All documents and records brought by the staff were taken over immediately. Then the excavation of the first series of hidden files in Berchtesgaden itself and in the surrounding area began. The first interrogations of staff officers were also carried out.

One of the engineers dropped a 'casual' comment that he had recently been offered a job in Japan. This led to an in-depth interrogation to obtain important technical information. As an uninvolved person, he mentioned an incident that he probably considered of little note: he claimed that less than a month ago, around mid-April, ten submarines had left the port of Kiel loaded with the latest German air warfare equipment. These submarines would have taken the direction to Japan. When Colonel O'Brien was informed of this, he immediately sent appropriate recommendations to the Directorate of Intelligence, USAFE, which in turn informed the Japanese section of the intelligence agency SHAEF.

Staffs on all fronts of the Navy, as well as all ships in ports and at sea, were informed by telegrams. One of the largest searches for submarines of the war began. No one knew which course they had taken, and whether they were traveling together or separately. However, the search was carried out so intensively and carefully by ships from all allied countries that by the end of June six of the ten submarines had been intercepted intact. Some were close to their bases, others were dangerously close to Japan.

An air-raid shelter was secured on a mountain slope not far from the German headquarters, the [whose entrance? – note d. author] had been carefully covered with earth and camouflaged. Its existence was eventually revealed by an officer who had directed the camouflage operations. Namely, after realizing that there was a hole at the entrance large enough for a human to crawl through, the officer believed the hiding place had been uncovered and notified the USAFE force of the location.

[...]"

[Microfilm clip 591]

“When the contents were finally recovered, key document after key document was extracted and examined in detail. A series of files contained the correspondence of the '1. Group / 6th Detachment', an intelligence agency of the Air Force Ministry. The content related to the period from January 1943 to March 1945 and described the transports destined for Japan, containing all kinds of air warfare equipment, including Me-262 and Me-163 specimens, a certain number of V1 shells, explosives, bombs , bomb sights, many different types of radar, including the *Würzburg* and *Frey types,* radio equipment, telephones, teletypewriters, etc., as well as various aircraft parts. […]

O'Brien's troop received word of a "strange aircraft" sighted near a mountain hut near Salzburg. Investigations quickly revealed that this "strange aircraft" was a rocket-propelled helicopter that was unique in the world. The inventor and the people who accompanied him, who had perfected their invention with a great deal of work, now guarded it like a precious treasure. The helicopter was closely examined.

Even the first preliminary interrogations showed how enormously important he was. It was carefully loaded onto a large truck and taken to Munich. From there it went to France and was shipped on to Wright Field with the confiscated notes, drawings and detailed test descriptions that had been carried out by scientists and their assistants. After long and lengthy interrogations by technical experts assigned by USAFE, these individuals were locked in prisoner-of-war cages. [literally! – note d. author]

All that remained after ten years of work were memories of an unusual technical achievement. The world's only missile helicopter was found and benefited American scientists and the US government.

[...]"

Another interesting curiosity is contained in microfilm #593. A senior intelligence officer reporting on the course of Operation *Lusty* describes the character of rough-terrain troops scouring the occupied territory. He writes that each group was composed as follows:

"Officers [...] who were fluent in German, Austrian, Russian, and Slavic languages." The question arises as to why an officer leading intelligence

reconnaissance activities in the relevant area seems to have no particular idea of which languages the inhabitants of this area speak? He should have been dealing with this for a long time. Something like that is probably only possible in America. There is probably no question why it was not the Americans who developed the American atomic bomb.

However, let's get back to the heart of the matter ···

[Microfilm clip 593]

“In the six weeks that the operation took, over 500 key targets were evaluated and hundreds of outstanding German scientists, professors, technicians and workers were interrogated. [...]"

[Microfilm clip 596]

“Members of the Rural Forces often found clues in the 'targets' they examined that led to other facilities, which were usually investigated immediately. It often turned out that the Germans had prepared abridged versions of the most important documents and had hidden them but not destroyed them. After being pressured into revealing this information, the interrogated people revealed that they were often found in lakes, reservoirs, mines or barns, buried in shelters, buried in attics and basements of buildings scattered around, as well as hidden in prisons, mental institutions and even grocery stores. […]

The Aviation Research Institute Hermann Göring (near Braunschweig)

was an institution whose investigation proved most fruitful. Exploitation Division members arrived there on April 22 to organize and conduct a scientific evaluation of this facility. dr von Karman, General Arnold's personal aviation adviser, and his team stayed at this facility repeatedly for several days. according to dr von Karman, this place housed 75-90% of German aviation technical information. Information on research that has not been carried out in the USA to date could not be obtained earlier than after two years, even if corresponding research facilities existed there. It was estimated that the information on the development of jet engines obtained at the mentioned facility would enable the American research work to be shortened by six to nine months. [...]"

[Microfilm clip 597]

"(3) A document with complete instructions for welding plastics was found in Halle ["plastics", although logically aluminum alloys should be meant - ed.
author]. It is a method introduced by the German aeronautics industry and was based on gas fusion welding […] where the joint was as strong as the surrounding material. This information has been forwarded to the AAF for joint investigation with the Office of Scientific Research and Development.

(4) A facility and staff was found in Bad Kissingen that dealt with scientific research work in the field of acoustic guidance systems for rocket projectiles. An experimental control system developed there contained electrical circuits that were activated by sound. The research involved a projectile that automatically corrected its trajectory based on bomber engine noise. The research group was placed under arrest in the laboratory so that they could further develop the concept for the Allies.

(5) Ramjet engines with a thrust greater than 1.5

Tons were taken over (May 1945) with enough data to use these achievements immediately in the manufacture of high-speed aircraft.

(6) 'Altitude test beds' have been found at the BMW plants for testing engines that simulated an altitude of 40,000 feet [12,200 m] by supplying cooled air under reduced pressure."

[Microfilm clip 598]

"It is the largest German factory for the production of aircraft engines.
[…]
(7) Complete information about the *Freya, Riese 'G' Würzburg* and *Jagdschloss* radar devices could be found in a laboratory in Koethen.

(8) Following the discovery of an aerodynamic-ballistics research station at Kochelsee (circa May 15, 1945), USAFE Intelligence Command made personnel available to fully investigate this important target. Under the direction of Dr. Hermann, the previous director of the station, continued the work over 190 civilian German specialists. Over 100 detailed reports have been prepared about this station. The wind tunnel in Kochel has the largest cross section and is characterized by the highest air flow of all supersonic wind tunnels. The Air Force attached such importance to it [...] that they made the decision to immediately disassemble it and bring it to the United States. […]

(9) A huge amount of the most diverse documents was discovered, e.g. For example, files from the German patent office were found in the potash mine near Bach. They comprised around 225,000 volumes, including secret files. [...] These files were later evacuated and examined.
[…]
(11) Documents from a department of Speer's Reich Ministry relating to secret weapon concepts were secured. They were mainly dedicated to V-missiles, other missiles and jet aircraft. [...]"

[Microfilm clip 599]

"(13) Practically all of the newest types of German aircraft, some of which had not taken part in combat operations at all, could be taken over intact, or sufficient parts were found for the German mechanics to assemble them. At least one example, and in some cases as many as ten, of the aircraft listed below could be found, representing only a fraction of all aircraft types. Sometimes this required an intensive search throughout Germany. Eventually they were brought to the United States for study and further development: Messerschmitt's 1101, 1106, 1110, 1111 and 1112 series aircraft, the latter being particularly interesting because it illustrated a phase of coordinated aircraft development - a way which American planes were only just beginning to tread; seven manned rocket-propelled aircraft specially designed to intercept bombers; a jet-powered helicopter; the Flettner 282 helicopter; the Horten-9; the Ju 88 – a twin-engine, radar-equipped night fighter; the four-engine long-range transport aircraft; seven Me-163 rocket-propelled interceptors; ten He-162 - single-seat jet fighters; V1 type flying bombs – single and double seater (manned); Lippisch's P-13 fighter - a tailless supersonic flying wing equipped with two rocket engines [launch engines only - ed. author]; [...] three complete A-4 rockets (V2); Ju-290; missiles, seven of the FX 1400 - radio-controlled; Numerous flight equipment and instruments - various models of very recent design - were similarly shipped for further study. [...]"

[Microfilm clip 601]

"In just three months, 111,000 tons of documentation were shipped. [...]"

[Microfilm clip 602]

> “Over 200 officers were deployed to [preliminarily] analyze the documents. [...]"

[Microfilm clip 603]

> "It was soon discovered that, despite the vast quantity and exceptional quality of the material inherited, there were too many unanswered questions - too many mysteries about the various aspects of enemy air forces still remain unsolved. [...]"

In the further part, the documents about Operation *Lusty* contain various information concerning various research institutions and other questions. I have already mentioned the core research laboratories in Linnessrabe (Linnesgrabe). Of course, that's not all.

Microfilm clip 958 contains information about the development of a guided missile in Völkenrode that contained gases that shut down the engines of enemy aircraft and even armored vehicle engines ("engine-stopping gas missile to be used against tanks or aircraft"). Actually, that should surprise and shock me.

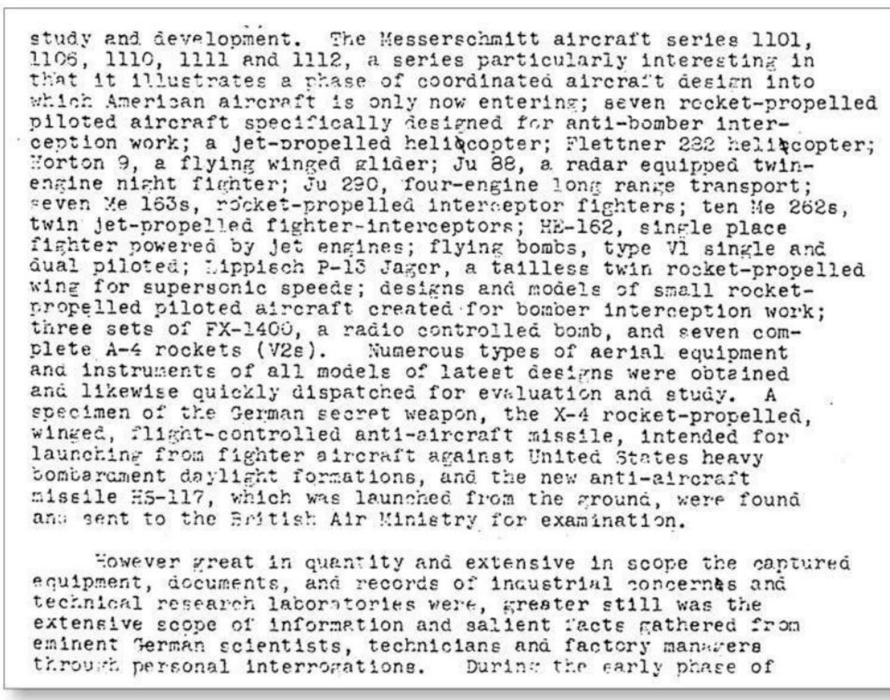
On the other hand, the Operation *Lusty* account contains descriptions of so many unusual achievements that the invention mentioned above seems perfectly ordinary ...

A little further down (the clipping number is not given) is an even stranger description. There is talk of a building at Weimarstraße 87 in Vienna, where a laboratory is said to have been in which work was carried out on "anti-flight rays". The research was conducted in such great secrecy that staff were strictly forbidden to leave the building—it was sealed. Elsewhere, a research facility of the Daimler-Benz company in Stuttgart-Untertürkheim is mentioned, where a device for "paralyzing" petrol engines at a distance of two to three kilometers was designed. The facility was completely destroyed by bombing before the end of the war.

The microfilm excerpts 1419 - 1420 emphasize the role of the Munich / Innsbruck region, where there are said to have been many institutions of the electronics industry of particular importance. Here, among other things, radar devices for the centimeter range are said to have been developed.

The microfilm excerpts 887 - 932 deal with the extent of the

Relocation of key factories and research facilities underground.
The report states that the Germans managed to get no fewer than 143 underground manufacturing facilities operational before the end of the war. Another 107 were under construction or planned, although further context indicates that this information is incomplete and likely does not account for the converted mines. As already mentioned, this complex of topics is related to the most secretive armaments projects, as they were usually given priority in the allocation of underground facilities.



study and development. The Messerschmitt aircraft series 1101, 1106, 1110, 1111 and 1112, a series particularly interesting in that it illustrates a phase of coordinated aircraft design into which American aircraft is only now entering; seven rocket-propelled piloted aircraft specifically designed for anti-bomber interception work; a jet-propelled helicopter; Flettner 282 helicopter; Horton 9, a flying winged glider; Ju 88, a radar equipped twin-engine night fighter; Ju 290, four-engine long range transport; seven Me 163s, rocket-propelled interceptor fighters; ten Me 262s, twin jet-propelled fighter-interceptors; HE-162, single place fighter powered by jet engines; flying bombs, type V1 single and dual piloted; Lippisch P-13 Jager, a tailless twin rocket-propelled wing for supersonic speeds; designs and models of small rocket-propelled piloted aircraft created for bomber interception work; three sets of FX-1400, a radio controlled bomb, and seven complete A-4 rockets (V2s). Numerous types of aerial equipment and instruments of all models of latest designs were obtained and likewise quickly dispatched for evaluation and study. A specimen of the German secret weapon, the X-4 rocket-propelled, winged, flight-controlled anti-aircraft missile, intended for launching from fighter aircraft against United States heavy bombardment daylight formations, and the new anti-aircraft missile HS-117, which was launched from the ground, were found and sent to the British Air Ministry for examination.

However great in quantity and extensive in scope the captured equipment, documents, and records of industrial concerns and technical research laboratories were, greater still was the extensive scope of information and salient facts gathered from eminent German scientists, technicians and factory managers through personal interrogations. During the early phase of

A page from the Operation *Lusty* report listing the types of aircraft intercepted and other types of air warfare equipment.

* * *

Here are some interesting, new and, I think, important ones Information to supplement this chapter:

This chapter (as well as the previous chapters) deals with the unusual development progress in the field of electronics. This pioneering area represents perhaps the largest "blank spot" as such areas as e.g. B. the great progress in the

Miniaturization or the introduction of semiconductors are virtually unknown to this day. I have to admit that I was missing an important element that -- "accidentally" appeared right after the war, namely the transistor. However, I found a little-known publication called Mare Tranquillitatis that sheds a slightly different light on this area. 130 This book describes, among other things, the following works:

> "In 1942, in his apartment at Methfesselstraße 7 in Berlin, a certain Konrad Zuse built the world's first (tube-powered) digital computer that could be controlled with a program. It was called Z-4, worked in the binary system, and the programming language developed for it was called 'Plankalkül'. For example, he could B. calculate a square root within five seconds and was used by the Henschel company until 1944 for the development of the Hs-293 guided missile."

Another example - quote:

> "In 1926, Julius Lilienfeld applied for a patent for a phenomenon he had discovered, which is considered to be the forerunner of the field effect transistor. In 1934, Oscar Heil was granted a patent for a circuit for amplifying electrical signals in crystal. A few days before the end of World War II, Heinrich Welker proposed a semiconductor amplifier. Documentation on this concept, as was the case with many other documents, was brought to the United States after the war." [emphasis added]

One could do this with the statement of the American President Eisenhower summarize the drafting of "Secret Projects of the DFS" was taken:

> "German technology was a good ten years ahead of Allied technology. Fortunately, the German leadership didn't know how to use this lead and realized too late what opportunities it offered them." [!!!]

As a supplement to this chapter, the following also fits perfectly Excerpt from Wojewódzki's elaboration entitled "Akcja V-1, V 2", which, of course, deals with American technology drainage:

"'No, they didn't knock my teeth out,' confessed von Braun, 'they even offered me scrambled eggs' [...]"

This is how it should continue - warm and hospitable. After the first interrogations, von Braun was taken to Garmisch-Partenkirchen, where there were already 500 experts from Peenemünde in a barracks building. The interrogations lasted longer here. Von Braun calmly described his vision for the future to the Americans. During an interrogation, he stated that his invention would bring Europe "within 40 minutes" of America.

"It will be possible to build research stations in space, to which parts will be delivered by rocket [...] And if rocket technology develops even further, we will be able to fly to other planets, starting with the moon [...]" "That, what we told the Americans," von Braun

recalled, "sounded like black magic to them and exceeded their imagination." Dornberger later said that to them they were "Bohemian villages." Professor Fritz Zwickly of the University of California, who is now a respected missile expert, said he felt "von Braun and the others were just making fun of them." The Allies were primarily at the forefront of German technology Interested. Shown are covers of selected UK Intelligence reports on electron microscopy, tape recorders, quartz watches and semiconductors. (NARA/BIOS)

picture gallery

The Panzerkampfwagen *Tiger*

The Panzerkampfwagen *Panther* (Photos: Die Wehrmacht / Signal)

The Messerschmitt Bf-109 in Africa. (Photos: The Wehrmacht)

Details of the Me-262. (Photo: I. Witkowski)

The Me-323 *Giant*

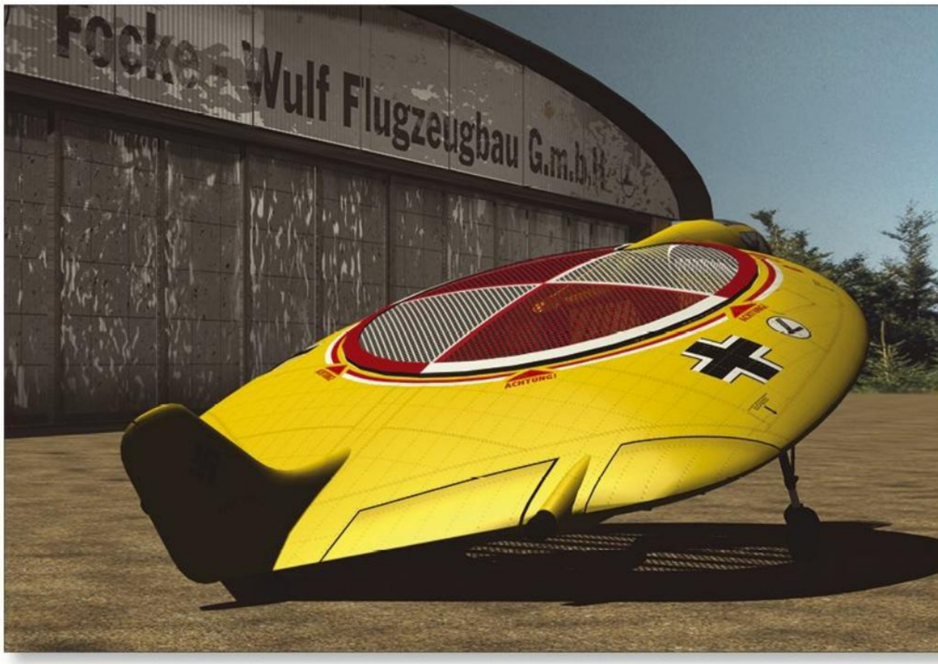
The Ju-52 (below). (Photos: The Wehrmacht / I. Witkowski)

The X-4 air-to-air missile. (Photo: I. Witkowski)

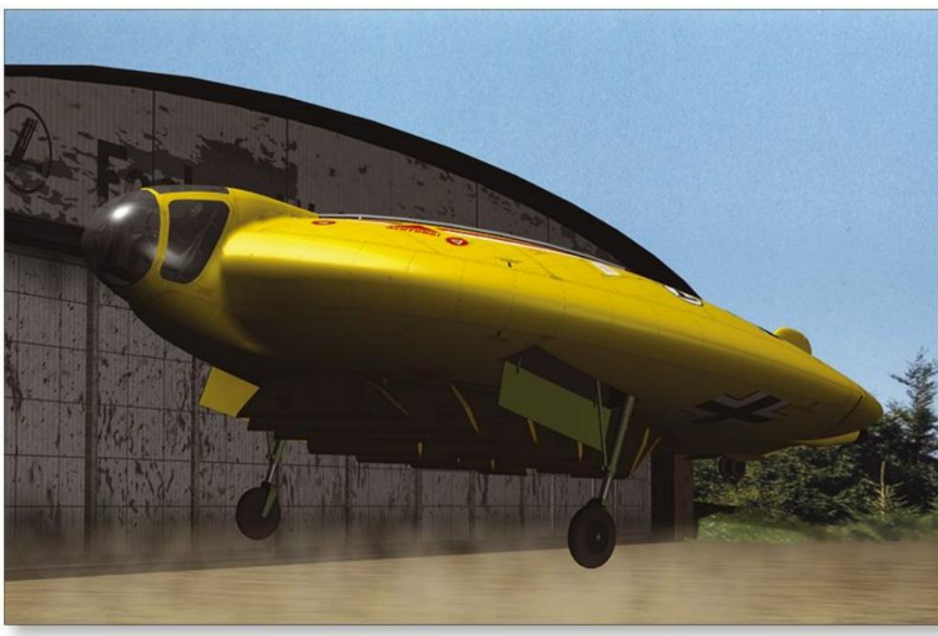
The "DB Jäger" fighter plane - a design by Daimler-Benz. (M. Ryÿ)

The EF-132 bomber - a design by Junkers. (M. Ryÿ)

The Ho-229/Ho-IX. (M. Ryÿ)



Focke-Wulf's "Flying Pancake" project - the illustrations are based on the patent documentation. (M. Ryÿ)

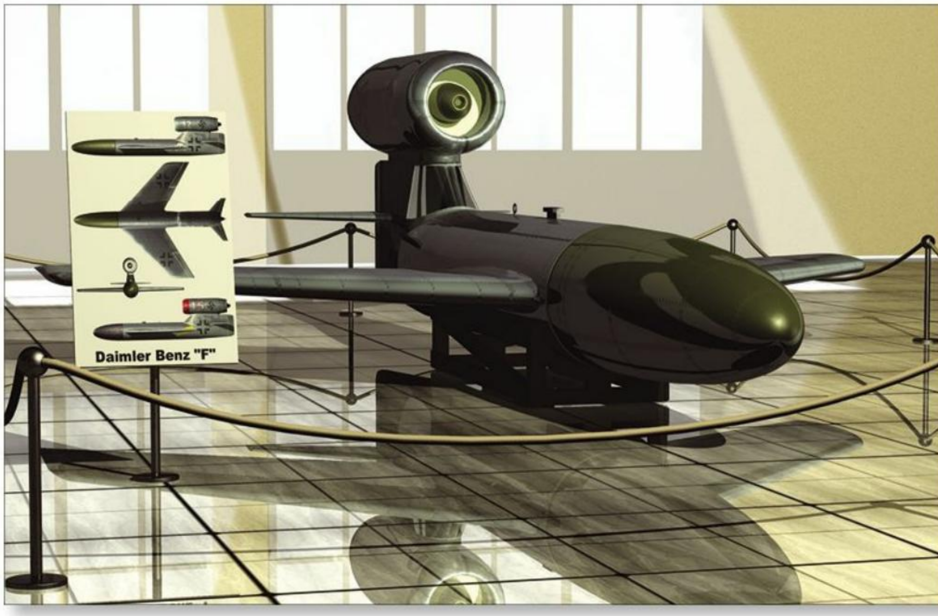


The Focke-Wulf Ta-183, armed with X-4 shells. (M. Ryÿ)

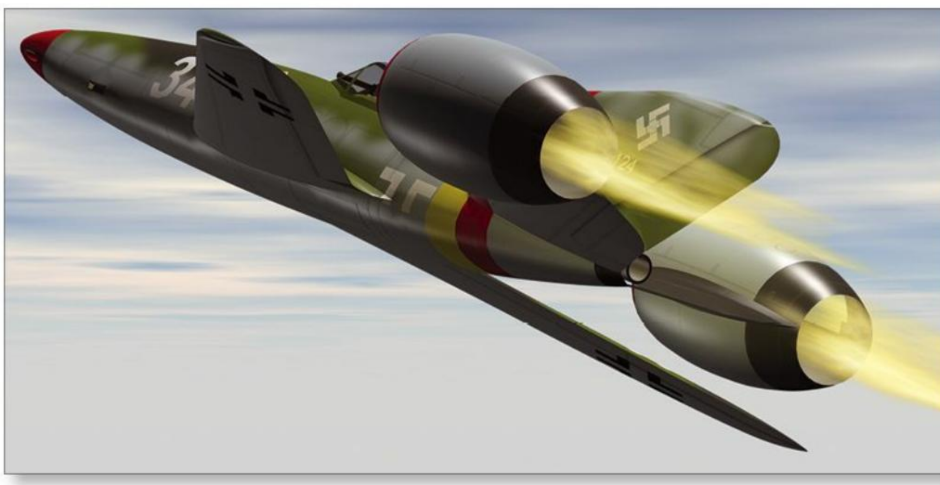
The Focke-Wulf Ta-183, armed with X-4 shells. (M. Ryÿ)

The Messerschmitt P-1109. (M. Ryÿ)

Lippisch's "trapezoidal" version of the P-13b. (M. Ryÿ)



The manned "flying bomb", powered by a BMW 018 engine and intended, among other things, for the transport of weapons of mass destruction. One of two versions (Project "F"). (M. Ryÿ)



The Skoda P-14

The Focke-Wulf Ta-283. (M. Ryÿ)

The Focke-Wulf *Triebflügel* on the ground and during the ascent. (M. Ryÿ)